APRIL 1961 3/6

AUTOMATIC DATA PROCESSING

JOURNAL OF MANAGEMENT AND INFORMATION SYSTEMS

A GAME OF BUSINESS

Is a pneumatic computer feasible?

Bank gains from switching to electronics

First steps in building a car

BMC HAVE ALWAYS LOOKED YEARS AHEAD!

Take their decision, in 1956, to order one of the first business computers ever built in Britain. The payroll of the 20,000 check employees in BMC's Austin factory is one of the most complicated in the country. So complicated, that the facts and figures needed by management were seldom ready soon enough to be used for any but record purposes. And so BMC and EMI joined forces and set to work on the problem.

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AUTOMATIC DATA PROCESSING

JOURNAL OF MANAGEMENT AND INFORMATION SYSTEMS VOL 3 No 4

APRIL 1961

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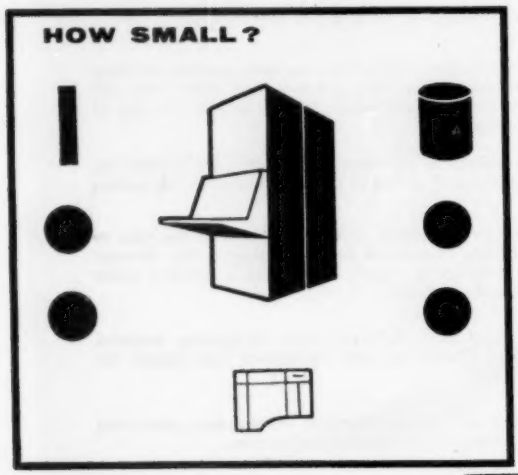

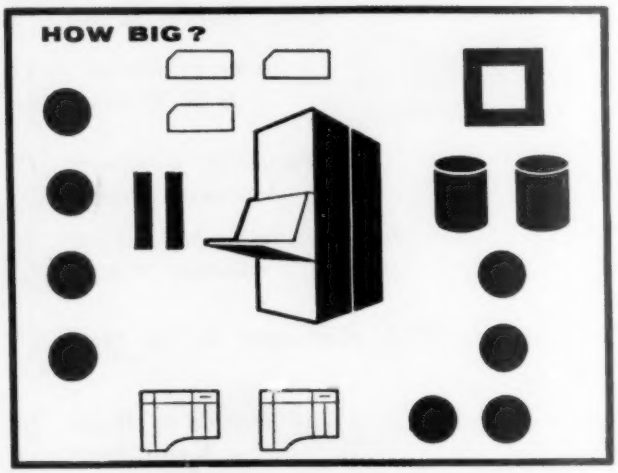

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More than businessman's chess

IT is to be hoped that during the next two or three years a great many executives will take (or create) the opportunity to play 'business games' of the type described by our contributor, Mr H R Watkins, in the leading article of this issue [A Game of Business, page 12]. Such games, which usually take no more than a couple of days to play, are guaranteed to inject a shot of new vitality into jaded, desk-bound executives: they demand concentration, stretch the mind, and are enormous fun to play.

However, the fun they provide is merely by the way, for these games are not designed to be a sort of businessman's chess. While it is probably true that the originators of *some* games had no clear thought as to their purpose—they were more interested in the notion of simulating a business situation and getting people to 'take decisions' to affect the model, than in thinking up reasons why people should want to play the games—serious purposes can be attributed to general management decision games.

First, researchers into business practice may learn something of how decisions are arrived at by groups of people—this is largely an academic purpose.

Secondly, and more important, business games provide management with means to learn how a company is run from the top, and with condensed experience of *actually doing* the running. Significantly, a number of American companies have seen the training possibilities of business games and incorporate sessions of games in their training programmes for middle and usually functional management who need to be converted from specialists to generalists.

Yet, to think of business games as only 'training aids' is to miss a vital point. If we hope that a great many executives will play these games during the next two to three years, this is because to take part in a business game suddenly gives one a whiff of exciting possibilities.

If it is possible to build a mathematical model of a simplified business situation—to express the functions of a fictitious company in terms of mathematical or logical relationships—it is probably only a matter of time before this is done for a real live industry and a real live company.

An example from the process industry may help to elucidate what this implies: at present it is possible before building a chemical plant to simulate on an analogue computer conditions that will be found in the plant. To be able to do this at the design stage is useful for confirming design features and ensuring no serious design mistakes have been made: the analogue computer becomes an 'electrical model' of the plant and the model goes 'on stream,' and the results of various adjustments can thus be determined before the chemical plant is ever built.

If a live model (though not necessarily an 'electrical model') could be built of not just a plant but a company, and various courses 'tried out' on the model before committing a single penny of company money, the effects on medium and long-range planning could be radical and the benefits could be enormous: results of several investment, production and sales policies could be accurately assessed in advance and the best course selected.

Clearly, this will not happen save in the long run, but to grasp the possibilities now might be a first step to a very profitable endeavour.

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  NOTE: UP TO 16 RANDOM ACCESS MEMORY UNITS may be linked for combined operation to provide random and/or serial access to over 130,000,000 numeric digits of information. (Over 80,000,000 if alpha-numeric.)

  SPEED: Information transfer rate is 100,000 characters per second

  ACCESS TIME: 0–200 milli-secs. (time-shared)

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- **N·C·R MAGNETIC TAPES** (alternative to, or in combination with the RANDOM ACCESS MEMORY)

  OPERATIONAL TRANSFER RATES: 24,000 to 60,000 characters per second

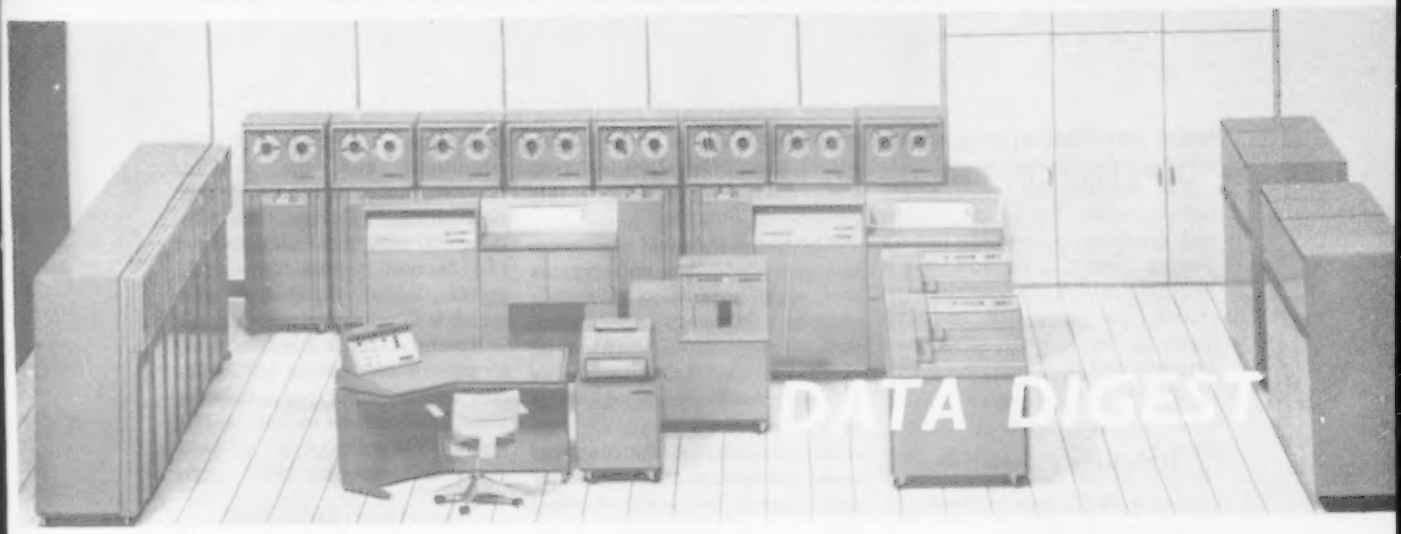

Photo: new Burroughs computer

News of the month at a glance

Six councils to form a syndicate

Since 23 London borough councils set up eight years ago an O and M committee, and—more important—a permanent staff of O and M officers to undertake work for the 23, a good number of O and M investigations and chores have been concluded, but perhaps the most interesting work that the committee's permanent staff have done is in connection with providing centralised computing services for six metropolitan borough councils.

Six adjoining boroughs—Greenwich, Bermondsey, Woolwich, Southwark, Camberwell and Deptford—will jointly purchase and run a large computer from some centralised inter-borough office.

Mr H J Dive, who directs the activities of the O and M committee's permanent staff, explains that getting six of the boroughs to form a computer syndicate is only a start, and other London boroughs might well follow suit.

As to what the computer will be used for Mr Dive says it will be put to (a) providing better information about the services which the boroughs give, and (b) overcoming some of the present chores.

A likely early application for the syndicate's machine will be payroll: the six borough councils between them employ some 10,000 people. In fact Greenwich and Bermondsey already prepare their payrolls on Leo machines on a time-hire basis.

The centralised office is likely to be established at Greenwich, and to cost about £264,000 to establish.

Interest in computers has clearly rapidly grown in local government administrative circles, and significantly of the 20 people on the permanent staff of the metropolitan boroughs' O and M committee nearly half are concerned with either programming or systems design work for computers, and recently more programmers were being recruited.

Now working

Austin's have two

Late last year the British Motor Corporation's Longbridge factory took delivery of an Emidec 1100 computer, and this machine has now begun work: sales invoicing and accounting, receipt recording and analysis of orders production schedules, sales statistics and stock analysis number among the tasks it is to handle.

Longbridge—an Austin plant—has, of course, seen a computer before. In 1958 EMI delivered a 'special business machine' whose specifications were never released and whose applications were kept unusually dark. Now it emerges that this machine has been successfully handling the 20,000-strong payroll at Longbridge.

Operating through the dual input of punched cards and magnetic tapes, the computer can produce the payroll—including printed wage slips in triplicate—at the rate of 1,400 employees per hour. The task of preparing such a payroll is significant when one considers the immense number of separate calculations needed to compute even one wage slip—involving basic rate, time worked, piece-rates, bonuses and such deductions as income tax, national

health contributions and welfare scheme subscriptions.

The machine also carries out labour costing for all car models and produces a complete factory costing report. In addition it publishes a full cash analysis to enable the computer make-up team to check their work, and prepares and prints all production accounts.

Briefing executives

. . . with overseas experience

Last month Gillette Industries gave over 70 of their executives a briefing on 'electronic calculating machines and integrated data processing.' Mr W F Brackman, an American executive from the parent Gillette company who has been seconded to the British company for a two-year spell both to 'impart experience' and learn how things are done in Britain, gave an outline of his experiences in introducing a computer system while he was Controller of the Gillette Safety Razor Co of Boston, USA, during 1955-58. The American company installed an IBM 650 in 1956.

This was followed by an outline from Mr E L S Weiss, manager of Gillette's O and M department, on the computer plans the of British company. An IBM 1401 system has been ordered to replace card equipment now operating at the company's Isleworth factory.

'As an international company,' says Mr Weiss, 'we derive immense benefit by speaking the same data processing language throughout the organisation, and being able to use the equipment of one company to train the operators and test the routines of other companies.'

At Gillette, Isleworth, the new computer would be used to obtain information quickly. By combining sales statistics with agency records and market research information, sales forecasts could be produced. These sales forecasts would go to production planning, and could then be turned into production forecasts.

The computer could also calculate total production, and compare this with production forecasts, showing deficiency of surplus; and tell the various stocks at all levels, giving the quantity of finished goods in hand—on a daily basis.

As a by-product, the computer could produce detailed reports of each stage of production, showing how much each machine had produced, the amount of scrap and breakdown time, and analyse the reason for machine faults as well as a host of other information which might be required.

Finally, said Mr Weiss, accounts would become a summary of all other information—information reported in terms of money as opposed to production or sales quantities. This 'advanced' conception was essential to have when planning a computer, and is what was meant by 'integrated data processing.' If the new equipment could do, successfully, all routines required it would handsomely repay additional expenditure.

Bids analysed

Expected savings— $5 million

The US Navy have devised a system of analysing the bids tended by companies competing to sell jet fuel to the US Department of Defense which is expected to chip off $5 million from the annual $400 million cost of fuel.

Developed by mathematicians and operational research analysts of the Navy Management Office and the Military Petroleum Supply Agency (MPSA) the system employs linear programming techniques and a computer; the computer problem involves 500 complex interrelated bids from 95 oil companies, and takes into account the needs of 300 military users, legal restrictions, physical conditions and the shipping routes from each bidder to each destination. Given the basic data, 500 million calculations later the computer provides a procurement and distribution plan which is the cheapest possible.

Recently, it took less than a day to process bids to the MPSA for six months supply of jet fuel—some 2,000 million gallons costing about $200 million.

Another £625,000

RAOC orders again

Already due to pay out about £625,000 for an Emidec 2400 computer ordered in July, 1959 (and due to be delivered this June), the Royal Army Ordnance Corps has now ordered another Emidec 2400 for its depot at Donnington, Shropshire, to control stocks of technical stores.

The first 2400 machine will be established at the RAOC's Chilwell depot, where its main task will be to maintain full records of the Army's stocks of motor transport spares, to compile accounts and to calculate the requirements for re-stocking.

Donnington's computer—which is presumably still two years away—will control stock levels of 270,000 different items of stores, from radar equipment to refrigeration plants, and from revolvers to guided weapons. Some 30,000 transactions occur each week in Donnington, and it will be part of the computer's role to vet stores demands: that they are reasonable for the type of Army unit making them and that the components requested are applicable to the main equipment mentioned.

Highly sensitive stock control should, it is expected, result in lower stock levels being held.

When both the RAOC machines are operating, about 85 percent of the range of Army Ordnance stores will be recorded and controlled by computing systems.

What is a Data Centre?

—it's not a service bureau!

In announcing the opening next June of a new computer centre at 58 Newman Street, London, IBM emphasise that it will be a 'Data Centre' and not a computer service bureau. The difference is, of course, in the way the terms are defined. At a Data Centre—a whole chain of these are operated by the American IBM company—IBM maintain equipment, (in Newman Street this will comprise a 7090 and 1401) and the commercial and scientific organisations who wish to use the equipment write their own programs and operate machines themselves. This is in contrast to the coddling treatment given to customers of IBM's service bureaux, on whose behalf programs are written and machines operated (card punching and design work is also done, sometimes).

IBM claim the Data Centre idea carries three advantages: first, it cuts the cost of using the equipment to the minimum; secondly, the customer keeps full control of the job; and thirdly, the experience gained is valuable if that customer later decides to install his own equipment.

In fairness, it must be said that the Data Centre idea is no more than a new name for the 'open shop' principle on which Ferranti and other manufacturers have made their computing centres available.

In the Data Centre building in Newman Street IBM are providing offices for CEIR (UK) Ltd, the research and computer services organisation, who have contracted for a large portion of the time available on both the 7090 and 1401 machines.

However, IBM are not the only computer company to have set up shop in Newman Street; almost cheek by jowl to the Data Centre are the new offices of Ferranti Ltd which already house four computing systems and which will eventually be augmented by an Orion system to provide a considerable time-hire service.

Newman Street may become the Harley Street of the computer world, but one company that is unlikely to establish a centre there is English Electric. At Kidsgrove in Staffordshire, English Electric already have two Deuce machines fully occupied on service work—and one machine has been linked to magnetic tape units—but future plans for the Kidsgrove centre included a completely new building to house both the computer centre and the company's computer assembly workshops and two more machines—a KDP 10 with magnetic tape units and high-speed printer and a KDF 9, the fastest machine in the English Electric stable.

A recent visit to the Kidsgrove centre uncovered one idea that a harrassed data processing manager who finds himself short of card-punching operators might care to consider. One very big service job English Electric landed required the preparation of a phenomenal number of cards: card-punching operators are hard to find at the best of times and usually have to be trained, but to train extra staff for one job of limited duration was obviously out of the question. English Electric got round this by employing part-time staff who merely mark cards which are then fed to a mark-sensing punch.

A card-punching operator works, of course, faster than one that merely marks cards, but then earns more, and so in a case where speed was not of vital importance an economic case for marking instead of punching cards might be made.

JOB MARKET REPORT

AT a conference recently I spoke to an executive of an old-established firm which has recently had a shot in the arm in the shape of a young and vigorous new management.

'We applied for an O and M man recently,' he said, 'and we got about 18 replies. Good quality mostly. But there are the people about, nowadays. We advertised also for a costing clerk, quite a minor post. We had eighty-five replies, and many of these were highly qualified people. It's all a question of public image. If people think you're going places, they're anxious to get on the band waggon. If they think you're static, they move on.'

I told him of the complaint of the large firm (mentioned in last month's Job Market Report) that they trained up men for computer and O and M work, only to find that they moved on to better jobs outside the firm.

'There's always that sort of inflation,' he said, 'whenever trained men are short. People are always prepared to pay that much more. But then, money isn't the only consideration. People don't move unless they are frustrated in some other way. If there is leadership in the firm, you'll find the wage packet—unless it's quite out of ratio to current salaries—is very much a secondary consideration. Incidentally, talking of that firm X, they may lose their people, but I don't know where they go. They certainly never apply to us. All we get are people from Y.' He named a large and 'established' computer firm. This was merely one man's opinion and one firm's experience, but it seemed to confirm the general trend in recruitment and computing 'birds of passage.'

Elliott Brothers, who have been responsible for so much in the

Leo joins up

IF YOU were an Army Officer, in the Gordon Highlanders for example, and your pay were assessed and issued by the Regimental Agent, then all the complex calculations would be carried out by a LEO Automatic Office.

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A new LEO—a faster service.

By 1962 a new LEO—LEO III—will be at work in the LEO Service Bureaux in London and Johannesburg and in several industrial concerns. LEO III is fast even by computer standards. It is fully transistorised. It reads and records on high-speed tapes. It prints its results on an Anelex machine at 880 lines per minute. Special buffer units ensure that the computer itself never has to wait for ancillary equipment to catch up with it. It can work on several jobs at the same time, automatically sharing between them its magnetic core store of up to 320,000 digits. And, no expense has been spared to make it more reliable. In fact, LEO III is so reliable that special 'breakdown exercises' have had to be devised to keep maintenance engineers in practice.

LEO III and you.

LEO III is versatile and powerful enough to handle your accounting, invoicing, sales analysis, stock and production control and any engineering calculations you may need done. In your organisation or working for you on a service basis, it can help you improve efficiency, save time and money. Come and talk it over with Leo Computers Ltd. They have been making computers for industry and operating them against the clock for nearly ten years now. You will find them experienced, imaginative and very realistic.

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automation world, have created a new grade, that of Establishment Manager. The mental association with bowler hats, episcopal gaiters, and the *Times*, is irresistible; but this grade does tend to emphasise the truism that when you take on a computer, you have to build an 'establishment' round it. Recent advertisements confirm that fact; Alfred Bird, the food manufacturers, who are to be a pioneer user of the ICT 1301, have advertised in the past month for a senior programmer, a chartered accountant for O and M and a statistician. Richard Thomas and Baldwin have advertised for an Operational Research executive, a senior O and M officer, and a Financial Accountant. Decca wanted a leader of Operational Research as well as a Hollerith supervisor, though this does not necessarily imply a correlation between the upper and lower ends of the organisation scale. Dunlops, who advertised for O and M men in February, were in March seeking senior programmers for their Leo III and IBM 1401 installations (yet to be delivered). Fords, too, requested both senior and ordinary programmers for their Leo II.

Training is another aspect of computer operation that is receiving attention in the advertisement columns. ICT have just advertised for two lecturers for their training school; these people, who do not have to be computer experts—though teaching and lecturing experience and knowledge of business statistics are desired, will be trained within the ICT training caucus. This expansion of training becomes necessary as more of ICT's customers come there to be trained; both programmers of Alfred Bird and of University of London—another eventual 1301 user—are offered full training with manufacturers. Fords and CAV offer full training; both are Leo customers; and British Oxygen, another Leo customer, ask of their future programmer and computer operators 'a willingness to train.' All of which seems to suggest there will be more pressure on the training people at Hartree House.

★ ★

Data processing managers are most sought after: Elliott Brothers offer £2,500 for a computing centre manager 'capable of controlling experienced programmers.' British Nylon Spinners want a deputy supervisor, with a thorough knowledge of the whole range of IBM and ICT equipment. De Havillands 'are taking a fresh look at their data processing problem . . . and now need a manager' (De Havillands are poised to sign an order for two computers). A manufacturing concern, unnamed, has specified fairly narrowly its requirements for a data processing manager. These comprise a 'thoroughly sound record of experience and achievement in this field; a university degree or business qualification; and management training and experience in commerce.' For all these qualifications the rate for the job —£1,500 to £2,000 seems only a moderate remuneration.

★ ★

Breaking down the month's vacancies for programmers, we logged 14 vacancies, including two 'repeats.' The companies were mostly giants, Ford, Dunlop, GEC, ICI Paints Division, CAV and British Oxygen; others in the chase included the Milk Marketing Board, Metropolitan Boroughs and London University. Of the programmers required, there were three advertisements for seniors, three for trainees, and six for programmers *tout court*.

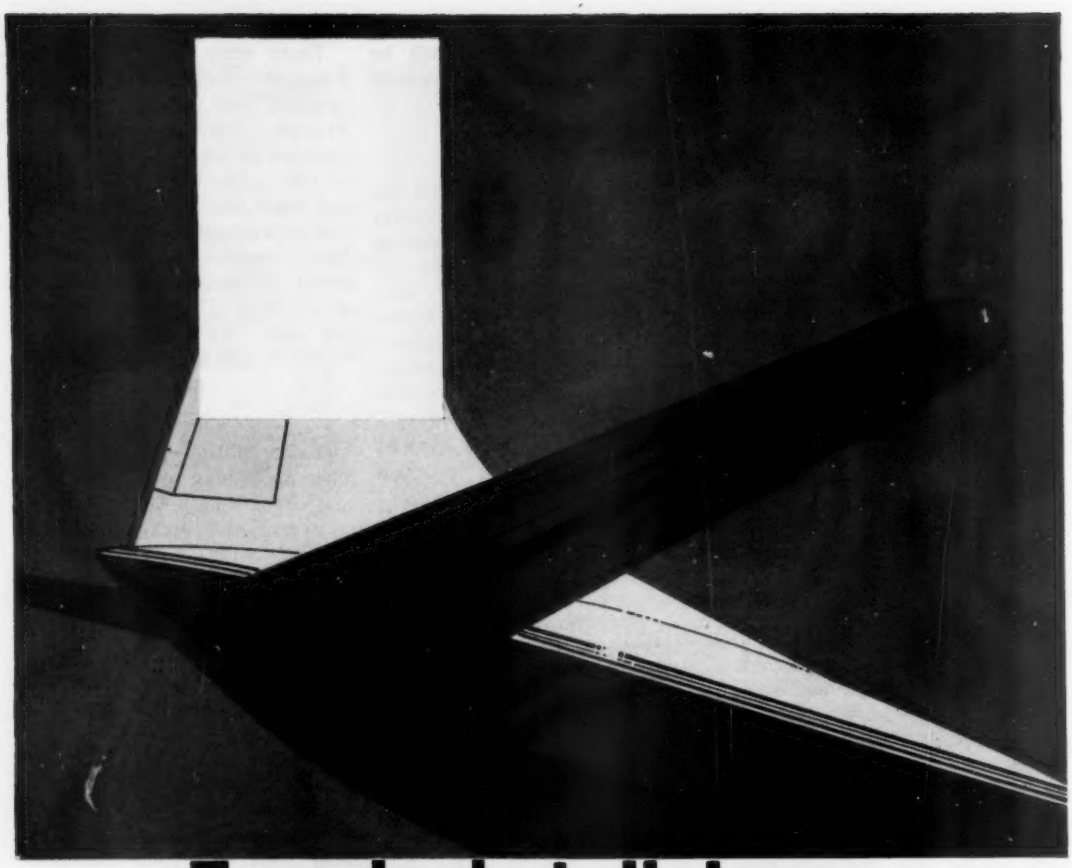
One of the firms advertising, Dorothy Perkins, very kindly sent us their findings; 19 applications were received for a trainee programmer vacancy, of which four were short-listed, and one chosen; the company were surprised by the response, which was more than they anticipated.

There were four Operational Research vacancies, and one vacancy for an Operational Analyst, whose qualifications included an ability to sell the idea of OR. Mathematics, statistics and engineering were required, as well as practical experience of OR. The companies were reticent about salaries, though a margin of £1,700 to £2,100 was given in one case. Age limits varied between 23 and 40.

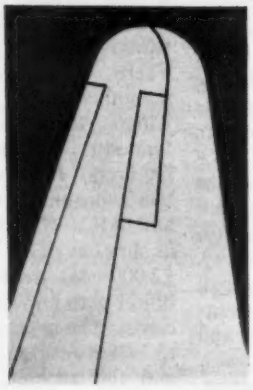
★ ★

O and M continued to be the most flourishing and demanding category. It is possible to have an organisation and methods department without the immediate intention to mechanise or computerise. On the other hand, a great many of the firms who advertised had in fact a computer on the staff, as Alfred Bird, Davy and United Engineering, Hawker Siddeley, etc. It was interesting to see that at least six of the vacancies specified an accountancy qualification as a basic requirement. Of the 16 vacancies there were two food manufacturers, Birds and Batchelors, and one retail distributing chain, British Home Stores; British Petroleum were another distributive giant in the market. There were two big primary manufacturers, papermakers Albert Reed, and Davy and United; two computer manufacturers, EMI and GEC, and two consultants, Urwick, Orr, and AIC. Salaries ranged from as low as £750 to as high as £2,000—for a senior O and M officer with knowledge of punched cards. The average salary seemed to be between £1,250 and £1,750, and the average age group between 27-40. O and M experience was required in only five cases, and in one case it was felt to be 'desirable'. Up to three years' experience was required for a man in the £1,300-£1,500 bracket.

DAVID ROACH PIERSON



Tuesday's tailplane



There is no doubt that the tailplane will be there on Tuesday– or that every other part and sub-assembly will be available on the scheduled date.
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It is suitable for every type of organisation – large or small – whether manufacturing turbo-jets or children's bicycles.
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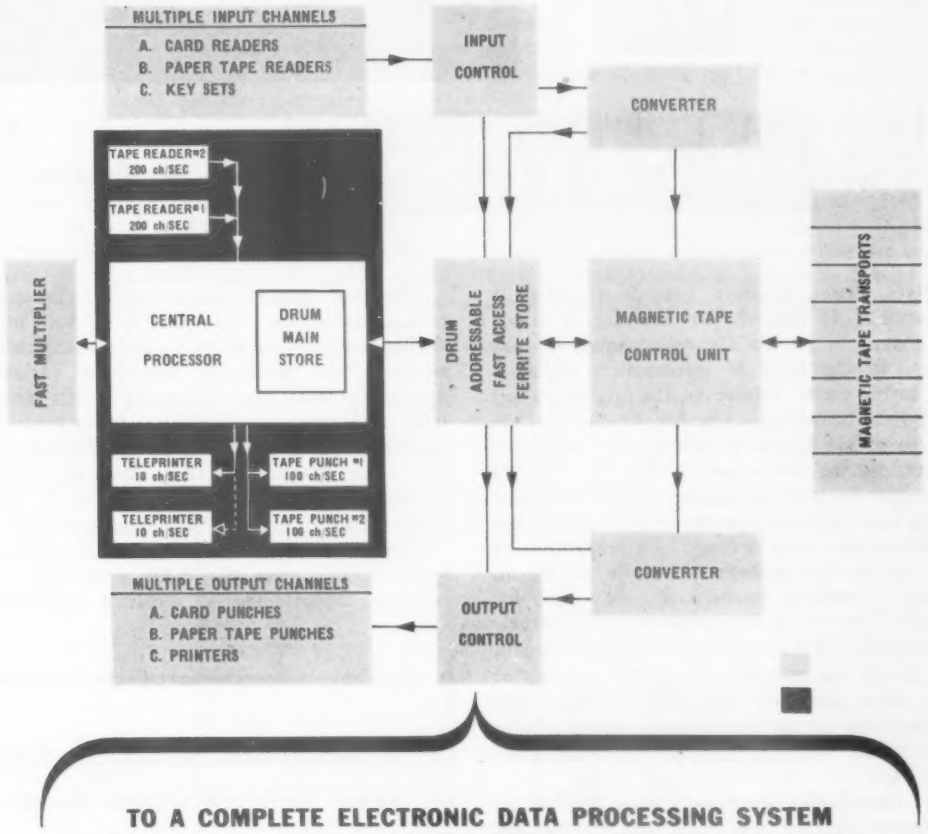
The great advantage of the STANTEC computing system is that it is strikingly versatile and adaptable to changing conditions. The system is always completely adequate for the efficient handling of present requirements, yet additional units can provide increased capacity and facilities at any time.



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A GAME OF BUSINESS

H R Watkins

THE term 'business game' is normally applied to describe an exercise in which groups of people are called upon to take decisions in the light of information which is placed before them. However, the first important distinction to be drawn is whether the object of the play is to obtain further knowledge, or whether it is to educate the participants. The first type of game might be used for example as a means of studying how decisions are made by a group and how individuals react within such a group. A second use is, by analogy with war games, to simulate an existing business situation and for company executives to represent the roles of their own company and its competitors, in order to gain insight as to the outcome of various courses of action. Such games are specialised, and it is these with which this article is concerned: namely those business games which are intended to teach a set of principles.

When considering business games devised as management training aids, two features become quickly apparent:

(a) Some games require a computer; others do not.

(b) Some games simulate specialised management situations; others a general management situation.

The main value of using a computer for games is that it enables more flexibility to be built into the decisions which are taken by the participants. In non-computer games the number of variables is necessarily small and the values which these can take are limited; nevertheless, many such games provide adequate opportunity for decision taking and when practice has been obtained by those in control, results can be fed back to the participants sufficiently quickly to sustain pressure.

Games have been developed which are designed to teach managers particular techniques. It is possible, for example, to illustrate with a game,

A close look at one business game highlights how these games are organised and what purpose they serve

the use of the ' economic order quantity ' formula in inventory control. (This is the standard approach to the problem of determining the optimum batch size to make in order to minimise the sum of the two types of cost involved, namely set-up or ordering costs, which are independent of the amount made, and stock-holding costs, which vary linearly with the size of the order.) Another example is a game which aims to teach the elements of Linear Programming based on the assignment of teams to various jobs. In such games the objective can frequently be clearly defined and a unique solution exist.

The type of business game which has aroused most interest is that designed to simulate a business situation, so that executives who are being trained can be placed in this environment and made to deal with some of the problems which occur in real life, but presented in the game in a much less complex form. Usually such games are competitive; either in a form in which a number of companies are endeavouring to sell products in a common market, where the activities of one competitor adversely affect the others, or where teams are confronted with the same situation involving the use of men, machines and money, the outcome of which can be expressed in terms of cash and the results, stage by stage, are made known to all.

The best known non-computer game of the former type is due to Andlinger[1] and it has been the basis for the development of many others including the game developed for Shell-Mex and BP Ltd, with which this article is mostly concerned.

In considering this particular game two aspects need to be clearly explained:

(1) The situation as it is known to the players.
(2) The underlying rules operated by those controlling the game.

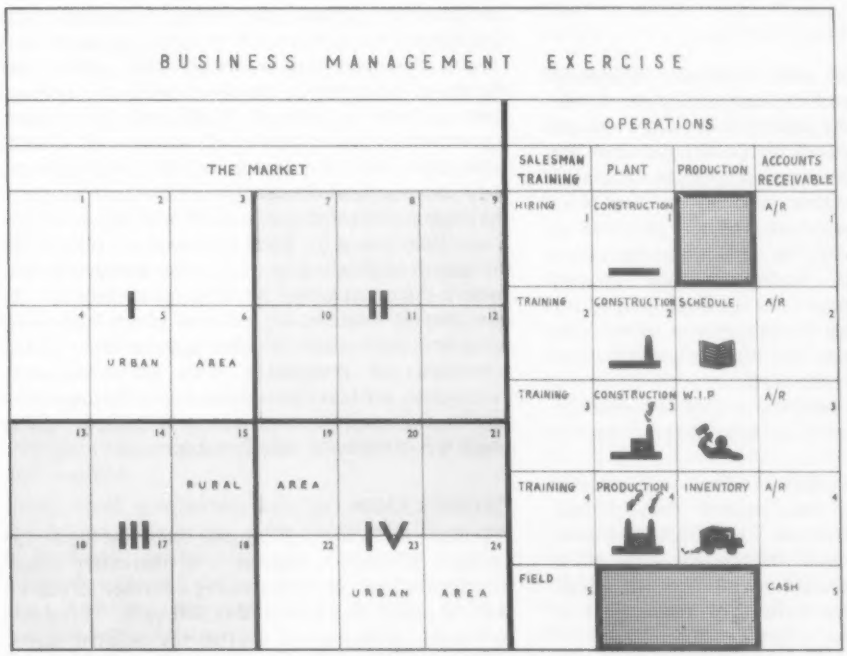
In general, the training section of Shell-Mex and BP who have been running sessions of this game for the last two and a half years and who have put some 250 ' students ' through it, have had to vary little the ' situation ' as it is known to the players.

Four teams of four members take part in the game; fewer than this number imposes an undue strain on a team and when there are more than four or five members there is a tendency for some to remain on the sidelines.

EQUIPMENT

A Control Board (see below) is used by each team, the left-hand side being divided to represent 24 sales areas, the right-hand side operations, and coloured counters are used to record the movement of salesmen, the progress of items through production, etc.

Two forms are also completed; each company uses a Decision Form in duplicate, each quarter to record what they propose to do, where their salesmen are to visit, and the amounts of money involved. Each company has an umpire attached to it, and at the end of each quarter, when the sales are known, he provides his team with a Quarterly Summary showing its financial position. It was found that



Each team has a Control Board which shows 24 sales areas, and (on the right-hand side) operations. Counters are used to record the training of salesmen, the construction of plant, etc.

when teams completed the Quarterly Summary the game was often held up in the early stages through inexperienced players completing it wrongly; care has now to be taken, however, to ensure that the teams understand the Summary and what entries imply.

TIME PERIODS

Each period represents three months of activity. At a given deadline the completed Decision Forms are collected by umpires who then report to the chief umpire and he allocates sales. How this is done is described later.

Immediately that is done one copy of the form is returned to the teams who can begin to plan their campaign for the next quarter while the umpires are completing the Quarterly Summary. When these are returned a new deadline is set. It takes 3-4 minutes for the sales to be allocated, and about the same length of time for the Summary (since parts can be filled in while the team are making their decisions). Consequently it is possible to set deadlines about 15 minutes apart so that a year's operations are completed in an hour. At the beginning of the game no sales are possible while the companies are starting up, so that the umpire sits in with his team in completing the records for the first year; this takes about 40 minutes.

The game is preceded by a fairly full briefing session since it can only proceed smoothly if all the players understand the rules and misconceptions are straightened out.

THE MARKET

The companies sell units of capital equipment at a price of £400, and can operate in any of the 24 areas into which the market is divided. (In the Andlinger model, units sell for £4,000 and there are fewer of them.) Each area has a certain potential allocated to it, such that in every quarter most areas will contain customers who are prepared to buy, although there may be some areas with zero potential. Customers buying in one quarter normally buy in the next. At the beginning of the game the market is an increasing one so that the over-all potential rises, but players are informed that a recession may take place.

It is possible for a company to find out what the total market potential is at any time by paying £800.

The 24 areas are divided into four regions each of six areas in order that market research and advertising can be carried out. For £8,000 the individual potentials of each of the six areas of a nominated region is available, and after the initial payment an up-to-date review of the region is provided at any time for a further £800.

A second grouping of the areas is into two urban and one rural district; in an urban district a salesman can get round an area twice in each quarter while in a rural district only one call a quarter is possible. It is advisable in the briefing to emphasise that the product is such that the potential of a rural area is not necessarily lower than in an urban district.

If a company wishes to know what market share it holds at the end of the year it can do so by paying £800.

SALESMEN—AND ADVERTISING

Salesmen cost £4,000 to engage and take a year to train; their salary is £400 a quarter. There is a possibility that salesmen will resign (this is a 5 percent probability and random number tables are used each quarter; as many numbers are looked up as a company has salesmen, and whenever the numbers 01-05 appear, this represents a salesman who has resigned). This does not apply during training.

Advertising is carried out by regions in quotas of £1,200 and up to five such quotas may be placed in any region in any quarter. It is effective only for the current quarter and in the nominated region or regions.

RESEARCH AND DEVELOPMENT

Companies may invest money in a research and development programme in the hope of producing a superior model to give them an edge over their competitors. Unlike advertising, research and development is a long-term project; the more the money that has been allocated, the greater the chance of obtaining an improved product. Investment is made in units of £4,000 and there is no upper limit. (A probability of success is associated with each level the Research and Development fund can reach, and each quarter random number tables are consulted; thus with £24,000 invested a company has a 33 percent chance of obtaining an improved product, so that if the number in the table is 33 or less, they have been successful.) A company is immediately notified of an improvement and units which in that quarter have been scheduled for production, and all subsequent production, are taken as equipped with the improvement. Competitors are told when these units reach the market six months later.

PRODUCTION

Initial plant costing £60,000 must be built to produce 50 units a quarter, and thereafter extra production lines, each producing a further 50 units, may be added at a cost of £12,000 each. Production is in batches of 10, so that the original plant

SOME OF THE EFFECTS THAT BUSINESS GAMES HAVE ON PLAYERS GIVE SOME IDEA OF THEIR VALUE FOR TRAINING MIDDLE MANAGEMENT:

1. An increased awareness of general business problems
2. Lessening of some prejudices
3. Giving some notion of the problems of adaptation
4. An awareness of the need for delegation
5. An awareness of the problems of conflict between company functions
6. Some experience of executive responsibility

can make 0, 10, 20 or 50 units each quarter, while with one extra line a company produce 0, 10 . . . 90 or 100 units a quarter.

The cost of the plant must be paid immediately construction is begun, and it takes three periods (9 months) for completion. When a company decides to build the plant (or later in the game, to increase capacity) a counter is placed on the Control Board to occupy the first square under 'Plant'; this counter is then moved down one square each quarter. In the second quarter of construction the company can schedule the number of units to be produced when the plant is operating six months later. In the next (the third and last construction period) these units become 'work in progress' and a second quantity is scheduled. Then in the next quarter the plant is in production, the first units are shown on the Control Board as being in Inventory and are available to sell, the second group of units moves to 'work in progress' and a third lot is scheduled. These movements are represented by counters on the Board, and it will be seen that when the game is in full swing there is a constant flow of counters down the board. Units are scheduled six months ahead, and pass from 'work in progress' to inventory and are sold. A company has to plan its production at least six months ahead and to anticipate the need for increased plant by at least nine months.

The total production cost of units, which is incurred at the work in progress stage is made up of fixed and variable elements; the former cost is incurred whatever the number of units made, if any. For the initial plant this fixed cost is £3,000 and the variable cost per unit is £100. Consequently with full production the fixed cost is £3,000, the variable cost (50 x £100) is £5,000 so that the 50 units cost £8,000 to produce, giving an average cost per unit of £160 (they are then sold for £400 giving a gross profit of £240). If production is cut to 20 units the total cost of these is £3,000 + £2,000, or £5,000 giving a unit cost of £250.

Units are added to stock at the actual cost involved, as worked above. When units are sold, they are taken out of stock at the average cost of items in stock. (This figure will fluctuate once production is varied and production costs change.)

FINANCE

Each company starts with £160,000 and from this the initial plant must be provided. In the opening stages companies are required to engage salesmen and they may also wish to buy market research, invest in research and development, etc. Furthermore it is necessary to give a year's credit to customers, so that the money resulting from sales in the first quarter of a year, say, will not be available until the equivalent quarter the following year; counters are marked with the amount due and moved down the Control Board (on the squares headed 'accounts receivable') each quarter.

Since salesmen are a year in training before they can make any sales, and it is a further year before the cash from these first sales become available, it is necessary for the companies to examine very carefully how they will manage their finances in the first two years. If a company wishes to call in outstanding accounts it may do so; the longest standing sums must be called in first and the cost to the company is 20 percent of the amount involved.

YEARS REDUCED TO HOURS

Probably the first business (or ' management decision ') game devised was for the American Management Association in 1956. Business games were inspired by war games—the ' dry exercises ' that military organisations in a number of countries, notably Germany, Japan and the USA, used to simulate conditions of war to teach strategy and tactics to military staff. However, modern business games owe much to operational research techniques and the electronic computer. Basically, a business game is a fictitious business situation, defined in terms of logical or mathematical relationships, in which the players act the roles of company executives taking decisions to produce, advertise, and sell a product in competition with other teams of players. These decisions affect the business situation, and some of the results are then revealed to the players so that they can take further decisions. This usually takes minutes, so that activities that take several years in real life to happen are in fact assumed to have happened in a matter of hours.

Many games have been developed since the American Management Association first got executives to spend $500 to play their game for two weeks. IBM devised their ' decision making laboratory ' exercise which is played frequently in Britain, and in the USA the Westinghouse Electric Corporation, the Universities of Washington and Oklahoma, and Esso Standard Oil Co have all devised games.

The games are mostly general management games whose aim is usually to train middle management in over-all company strategies and to impress the interdepandence of company functions—to make specialists into generalists.

A few games such as the Esso game and one devised by the Carnegie Institute of Technology are termed ' quasi-realistic ' in that they are supposed to simulate the conditions found in specific industries (oil and detergents), and the National Coal Board have developed a non-competitive game suitable for a monopoly industry where a team play ' against nature ' and try to obtain optimum results.

Other games known to have been developed in Britain, apart from the Shell-Mex game, include one run by Management Training Centre at Sundridge Park, and one devised by ICT, though this has yet to be played.

A number of games are described in a useful book by two American authors, Greene and Sisson, entitled ' Dynamic Management Decision Games '.

UNDERLYING RULES

The foregoing gives a summary of conditions under which the Shell-Mex game is played (a fuller account of the game's conditions is available[2]). How are sales allocated and what effects do decisions taken have? In fact, what are the operating rules underlying the game?

The original Andlinger game uses random numbers to allocate sales; the basic chance of a salesman making a sale is 25 percent and this chance is increased by advertising or getting an improved product. Thus a salesman calling in an area where the company has two quotas of advertising effective, has a 35 percent chance of making a sale; if on consulting the random number table, the next number is 35 or less, a sale is considered to have been made, and this procedure is carried out for all the salesmen in the field, each umpire working this out for his team. Results are then compared by the umpires, and where only one company has made sales in an area, all the potential sales of the area are allocated to it. If more than one company has made sales in an area these are allocated in proportion to the number of successful salesmen involved, any remainder being given to the company with an improved product, or the most advertising or the most invested in Research and Development, in that order.

The main advantages of this method of allocating sales is that it is capable of modification to meet particular requirements. For example, if it is thought desirable to allow teams to alter the sales price of the product, this can be done by giving the companies a choice of (say) five levels of sales price, each of which is associated with a given probability of making a sale; alternatively one could operate a rule (unknown, of course, to the players) which allowed, say, an increase of 5 percent in the probability of making a sale for every decrease of £10 in price.

The chief disadvantage is the fact that, because the initial allocation is made purely by chance, it is sometimes difficult for a team to reason logically why the decisions it has taken have led to the results that it obtained. It is true that in real life it is seldom possible to see an absolutely clear cut relationship, but this complete dependence on chance is thought to be unrealistic. In the Shell-Mex game an alternative method for allocating sales is used: every salesman calling will normally get 25 percent of the sales, the remainder then being allocated according to the amount of competition in the area. This makes the game more competitive and at the same time somewhat easier for the companies to infer what is happening in the market.

The game devised by Shell-Mex and BP's training section is included as part of three-week development courses for various levels of management in the belief that this is the best method of presentation.

An alternative setting would be at the end of a longer course concerned with teaching the elements of production control accountancy, management information, etc, where the game could be shaped towards giving players an opportunity to apply something of what they have been taught.

LESSONS LEARNT

Some companies have developed games to bring out a particular philosophy—the players might be told to make their plans in such a way as to show a given level of return on capital invested after a certain length of time; alternatively, another company brings out, among other points, the part that depreciation plays in the finances of an enterprise. These latter examples are, of course, cases where what is required to be taught is known, and the game is developed to bring out certain principles. The problem which concerns many of those involved in the use of games for training purposes is the extent to which they can be used for teaching broader issues. There is good reason for saying that such games bring home to many of the players the interdependence of the various activities in an organisation.

Many people, if specifically asked, would acknowledge this interdependence in company operations. Nevertheless it is found that on numerous occasions this is ignored again and again as sales people, playing the game, fail to schedule enough production, production engineers overproduce, or accountants refuse to loosen the purse-strings of the company.

At the end of a game players are given the chance to sum up their policies and assess how effective they have been. A number of measures of achievement can be prepared, and two at present used are Total Assets and Market Share; but in any appreciation of this sort, the long-term prospects of the company have also to be considered. A recession is usually introduced, and it may come at a time when some companies have obtained improved products; this benefits a company which is buying some form of market research, as it is better able to disentangle its increased sales arising from its competitive advantage from the general fall in level. Where the present game could be improved is in demonstrating the value of accurate and prompt information. The speed at which the game is played brings out the necessity for delegation among the participants in order to provide basic information. Experiments are being made at present in providing all teams with certain information annually about themselves and their competitors; for example, such data as:

Sales as a percentage of total assets.

Average sales per salesman and sales by area.

Market expenses per unit sold.

Average costs of unit in inventory.

This is in order to give teams an opportunity to make deductions from such information in planning their campaign.

EXPERIENCE SUGGESTS

In the course of developing and organising the game some points have emerged which may be of general interest.

Firstly, it is essential to make sure that the umpires understand the rules and the way in which records are kept, otherwise the game is liable to be held up in its early stages and the teams may never become fully absorbed in it. For the same reason the game must be adequately rehearsed before being brought into use and a full briefing session given to the players before starting. In the initial stages of developing or modifying a game, a company can be represented by one man and a second acts as umpire; by changing the roles an opportunity is also given for training umpires. Once a game is established it does not take long for an individual, even without previous experience of such exercises, to become a competent umpire. After a preliminary briefing and a day's session accompanying a trained umpire, a man should be able to interpret the rules and keep the records; obviously where the game is used to bring out principles or where individual umpires, as opposed to the senior umpire, are expected to analyse the results of a team's actions, more training is needed.

It has been found best to present the game in such a way that players cannot tell to within a year or so when it will end. This prevents teams from cutting out all steps which carry only long-term benefits and concentrating on immediate returns to achieve a good position at the end of the game.

WHAT THE MODEL IS NOT

The game devised by Shell-Mex and BP bears no relation to the activities that the company carries out in real life. This is deliberate. Undoubtedly, if a reliable model of a real situation could be established this can be used to bring out more lessons than any other; in the absence of such a one, it is better to avoid an appearance of realism, relating the situation too closely to the company, as this may cause disagreement between player and umpire as to the validity of parts of the model, and more important, to the possibility that the wrong lessons will be taught and wrong conclusions drawn.

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2. Watkins, H R W—' Business Games in Business.'—O.R. Quarterly Vol 10, No 4, 1959.

AMERICAN REPORT

from John Diebold and Associates, New York

The pneumatic computer is on the way

It will have no electronic parts, be reliable and reasonably fast —and it may be no more than a tenth of the cost of equivalent electronic systems

ALTHOUGH the unveiling of a fluid amplifier* was viewed quietly by computer designers who attended initial demonstrations of the device early last year, this disarmingly simple device has stimulated a spate of research activity in private industry. Inherent versatility of this device promises to transform it into an extremely effective tool for future designers and users of automatic data processing equipment.

Because variations of fluid amplifier circuits can be used in a number of ways (addition, subtraction, multiplication) and can be assembled to form a variety of functional and logic devices (AND and OR units, oscillators, flip-flops, and reaction controls), it is now possible to build an all-pneumatic computer that is reliable and economically practical.

Although not many organisations are willing to talk about their pneumatic circuit research projects, reliable and informed sources claim that more than 20 American companies are sponsoring develop-

* Developed by the scientists of the U S Army Ordnance Corps' Diamond Ordnance Fuze Laboratories.

ment work in this area. Total *private* capital being allocated and spent on pneumatic computer research was estimated to be between $100,000 and $200,000 per month as early as November,1960.

Kearfott Corporation (a division of General Precision Inc) announced early in February, 1961, that its engineers were working on an all-pneumatic, non-electronic digital computer which will operate in extreme temperatures without special heating or cooling equipment. Although Kearfott officials refused to predict when a prototype would be completed, at least one company is expected to introduce a marketable component incorporating fluid amplifier techniques within the next six months.

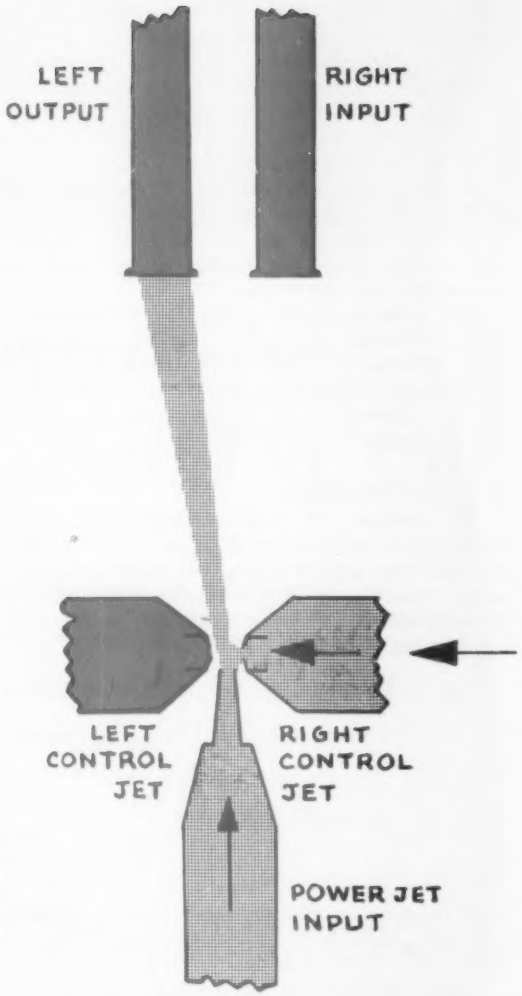
Events leading up to the March, 1960, announcement by the Diamond Ordnance Fuze Laboratories (DOFL) were predicated at a casual luncheon conversation about a year before. At that time, one DOFL scientist posed an interesting and provocative question. Why, he asked his colleagues, couldn't air be used instead of electrons to perform simple switching and amplification functions? Although they were not aware of it then, development of similar air-operated devices had been attempted before. Subsequent research revealed that patents dating back to the late nineteenth century provided details of possible circuit configurations. Despite this evidence of intense research activity more than half a century ago, no practical or significant hardware was ever developed.

In fact, a careful analysis of these old research reports showed that *mechanics* was the principal obstacle to the design of a practical system. If elements could be devised *without moving parts*, speed of response as well as reliability would be improved immeasurably.

This became the objective of the DOFL group (Dr R E Bowles, B M Horton, R W Warren) which eventually developed the circuits for the March, 1960, demonstrations.

One of the original DOFL models consisted of two sheets of plastic. Necessary air lines were created by tooling grooves in one of the sheets. The second sheet was fastened to it securely; exposed outside edges were sealed. Hoses feeding a supply stream and a control stream were connected to the appropriate fixtures along the outside edge.

The supply stream flowed through the grooves tooled in the plastic, passed through a small cavity in the centre of the two plastic plates, and entered one of two orifices which had been bored in one end of this cavity. Introduction of a control stream (directed at a right angle to the power stream flowing through the cavity) diverted the power stream to the second orifice at the end of the cavity. (See accompanying diagram.)



Working features of an all-pneumatic switching circuit. (Based on models designed by the US Army Diamond Ordnance Fuze Laboratories)

In other words, the presence or absence of the control stream determined which of the two orifices the power stream would enter. A switching action — without using electronics and without moving parts—had been achieved. Similar DOFL models showed how variations of this principle could be used to perform flip-flop, counting and amplification functions.

CHEAPER BY NINETY PERCENT

It is still too early to predict when automatic data processing equipment users will be working with pneumatically-operated systems. One impor-

tant factor—cost—should spur manufacturers sufficiently for them to design and build systems for the ADP market soon. One conservative estimate indicates that several basic data processing functions can be performed using the new pneumatic techniques at 10 percent of the cost of comparable electronic circuits!

So far, development work has been surprisingly fruitful. Although the slow speed of response is a limiting factor in the original DOFL models, this obstacle does not appear to be nearly as formidable as it did last year.

One experimenter has built an all-pneumatic device which has achieved a 25 microsecond pulse rate. Another prototype is reported to be capable of performing arithmetic operations of 10KC and higher. Complex logic networks are also being pieced together in several laboratories.

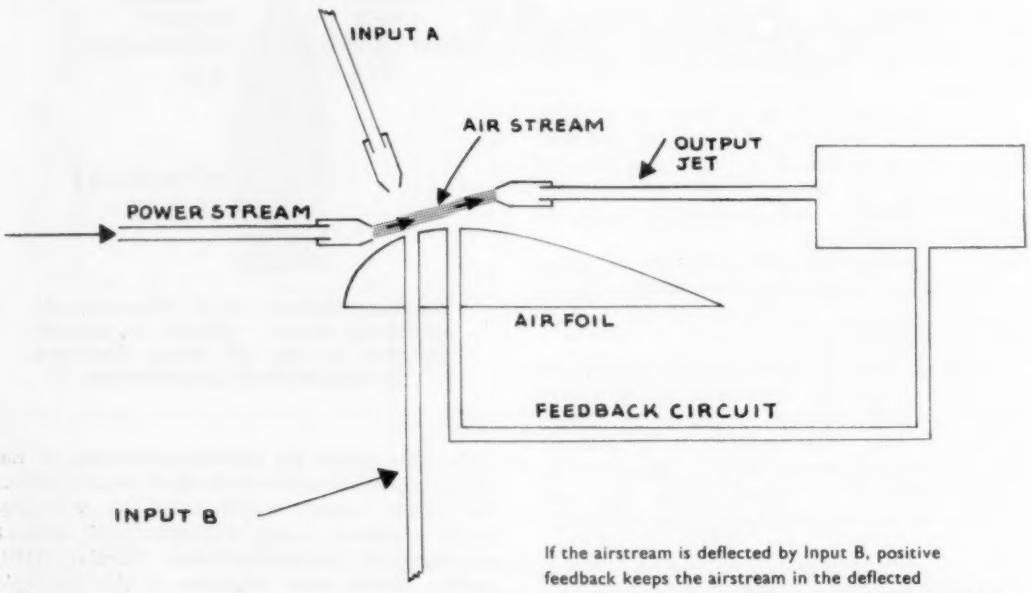
RUSSIAN INTEREST

The Institute of Automechanics and Telemechanics of the Academy of Sciences of the USSR has also been actively engaged in pneumatic computer research. Several examples of advanced air-operated circuits were exhibited in Moscow last summer.

Although all configurations of these models were markedly different from DOFL designs, they were quite similar to the American devices in two important respects: (1) structurally they were simple; and (2) they could be manufactured quickly using conventional fabricating methods. The Russians claim that the transposition from the laboratory to the production line will be rapid

The Russians may be planning to use counterparts of their experimental systems for integrating analogue pneumatic systems with digital electronic systems. Other possibilities: completely pneumatic small-scale digital systems; pneumatic computers for aircraft or ship autopilots; pneumatic computers for material sortation.

Basic elements in future Russian systems undoubtedly will include modifications of the building blocks which were exhibited last year in Moscow. These included: pneumatic digital 'plug-in' logic blocks, subminiature 'airfoil' relays; diaphragm-and-nozzle plug-in analogue amplifiers; complex special-purpose computer elements for optimizing problems and function generators. These elements provide a capability for assembling complex analogue as well as digital computers.



If the airstream is deflected by Input B, positive feedback keeps the airstream in the deflected position. A stream of air from Input A deflects stream downward so that it flows along edge of airfoil and misses output jet.

Key elements in two-input flip-flop suitable for memory applications. (Russian model)

How They Prepare to Build a Car

A document has to accompany a car through all its assembly stages, others have to be prepared to requisition parts — Standard Triumph took a long look at the procedures to generate the required documents for car production and came up with a quicker and more accurate method

Ronald Wilcox

CONSIDERABLE streamlining of the paperwork involved in controlling the production of cars has just been completed at the Coventry factory of Standard-Triumph International Ltd. In part this has developed out of the need for providing accurate coded information for the Leo IIC computer which was ordered by Standard-Triumph Group Services Ltd and installed in January: the computer is being used to provide stock control information, financial analyses, etc and to do this information on the use of components has to be relayed to it quickly, and to avoid delays, in a coded form. (An article on the production stock control work at Standard's, which—performed on the Leo IIC computer—has produced the integration of a number of clerical tasks, will appear in the May issue of AUTOMATIC DATA PROCESSING.)

The search for a solution to the problem of providing quickly documents for the production people and information for the computer's requirements involved examining manual methods, the use of 'gridded' documents and led finally to installing a number of Friden Programatic Flexowriter machines and associated equipment.

With the installation of the Leo computer, Standard had to draw up a specification for every car the company built. A specification of a car includes its destination, exterior colour, type of tyres, optional extras, etc. In any one model it is possible to have about 90 different items or combinations of items, and the compilation of documents on this basis was a formidable task.

At that time Standard's existing routines included the production of a combined sales tally and inspection document (which accompanies the car through the various assembly stages and is finally returned, duly completed, when the cars are released to sales). This was prepared from the initial order—and typed manually. From this was ultimately produced a body schedule (an order on the suppliers to deliver the required number of bodies within a given time), and when the bodies arrived they had to be inspected, scheduled for assembly track and a 'track build' programme produced. This involved

three operations—all done manually.

It was first decided to try to establish for each model the number of items likely to be required. A chart was drawn up for each model and codes allocated. When the girls typed the tallies they referred to a 'code manual' and at the same time as they typed in the descriptive information — heater, screen-washer, etc—they typed in the relevant code. But it was clear that this was not satisfactory because checking the coded manual for every model slowed up the production of tallies, and, ultimately, the production track. Another problem was that it did not ensure accuracy. The method was given a month's trial and it was found that, while the girls typed in the correct descriptive information, they were often putting in the wrong code numbers. This meant that, while the cars were built correctly, the information about parts used which was forwarded to the Leo installation was inaccurate. The trial showed a 15 percent decrease in the speed of typing tallies with a 10 percent rate of error in the coding.

It was next decided to investigate the use of a gridded document which combined codes with description for all possible combinations of each model. Completion of this document was effected by marking an 'X' against the required items. As the codes were tied to the description, coding errors were eliminated; furthermore, the form was so simple that typing was unnecessary. Unfortunately, the staff on production tracks prefer to see the exact specification on each tally and felt that a list of some 90 possibilities with, say, 15 requirements marked 'X' would be confusing and lead to errors in interpretation.

Following discussions with Bulmers (Calculators) Ltd it was decided to explore the possibility of using Flexowriter machines to produce the tallies. It was apparent that from the tally typing a by-product paper tape could be produced for the body schedule, and requirements could be generated on edge-punched cards (or a by-product tape) to produce the track build programme. At the same time as the body schedule was produced a coded paper tape could be outputted for passing through tape-to-card converters which would provide information on cards for use in the Leo installation. The method would eliminate much of the duplication that had existed previously and accurate coded information would be available for the computer.

A bank of edge-punched cards for the 14 models of cars was built up. There are somewhere between 70 and 90 possible variations to a model of car, and an edge-punched card was produced for every item. There are thus something like 1,300 cards in the bank.

With the new system incoming orders are routed through the same basic sorting and editing routines as in the previous system. On completion of this cycle, the orders are routed to a Regeneration unit. The operator of this unit selects from the master file the appropriate specification cards and feeds them through the Regeneration unit—there is an average of between 15-30 cards for each order—to produce a specification tape for each vehicle ordered (except for bulk orders which are dealt with in a different way). The specification tape is attached to the order and passed to a Flexowriter operator for tally writing.

The specification tape is fed into the reader of a Flexowriter, to record automatically the standard data on a tally sheet and stopping at predetermined positions for the manual entry of the order number. The information entered on the tally automatically consists of: model, description model code, product group, destination and destination code, exterior colour and code, trim colour and code, tyre size and code, tyre type and code, extras and codes, and any special instructions.

The output tape (giving body schedule details) obtained as an automatic by-product of tally writing is removed from the punch and attached to the tally to await sorting into scheduling sequence and the allocation of a rota number. When this has been done the specification tape is detached from the tally and fed into the reader of the Flexowriter, to record line-by-line on the body schedule document the standard data required by the body suppliers. The rota number for each vehicle is then added manually.

While the body schedule is being typed the Flexowriter outputs two tapes. One contains only coded information needed for the Leo computer and the other tape, produced on an auxiliary punch, contains information ultimately required for the final assembly stage which is produced as a track build programme.

For bulk quantities of any single vehicle specification the Regeneration operator produces one specification edge-punched card for the bulk quantity and one master tally for spirit reproduction. A single entry ultimately appears on the body schedule sheet and Leo tape showing the rota numbers (from-to) applicable. The edge-punched card is finally passed through the reader the appropriate number of times to produce the track build programme.

In the course of preparing for the installation of the three Flexowriters—a fourth is on order—it was found that the machine's program could be so devised that, while the whole of the information—heater, screen washer, type of tyres, etc—is shown on the tally, certain of these items were not needed on the body schedule

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What electronics did for them

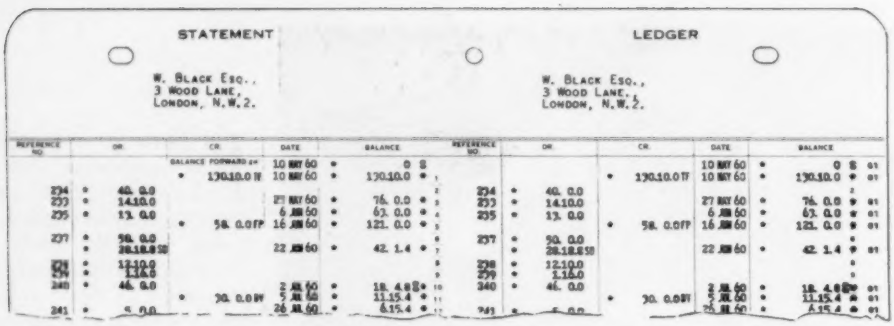
A small bank with a head office in London, they did some basic re-thinking, invested under £20,000 in electronic equipment and reaped the benefits—traditional tasks have been speeded up, some manual chores eliminated and human errors are rare now

IN banking, as in other fields of commerce, the search for better data processing methods is not confined to computers and document sorters. These are the 'giant steps' which get publicity; but in fact there have been important advances involving less spectacular (and less expensive) equipment. Nor is the application of such developments confined to the Big Five. One of the first banks to put some of them to work is the Standard Bank of South Africa, which has its head office in the City of London.

For the past 12 months, the Standard Bank has been processing a section of its current accounts on a semi-electronic machine of relatively modest cost, the National Post-Tronic. The installation is now being enlarged to three machines—when it will cover all head office accounts—but even then the total expenditure on equipment will be considerably less than £20,000.

The Post-Tronic system is designed to produce, on a smaller scale, most of the benefits associated with king-size automation projects: for example, the speeding up of traditional tasks, the elimination of some manual chores, and the reduction of human error. In doing so, it will help the Standard Bank to ease the problems of staff and accommodation with which all banks are faced today.

Some of these benefits have been achieved already, and there is no doubt that the savings will increase when the full installation gets into its stride. Meanwhile, the Standard Bank is gaining first-hand experience of a change in procedure which is now widely regarded as the root of bank automation—the numbering of customers' accounts and the



One of the changes adopted—a combined statement and ledger form

incorporation of account numbers in cheque and other vouchers.

Essentially a ledger and statement posting machine, the Post-Tronic does much of its work in a conventional way and produces conventional printed documents. The amount to be debited or credited to an account is entered on a keyboard. The machine then automatically calculates the new balance and prints full details on each side of a combined ledger and statement form. At the end of the accounting period the form is cut in half and the statement is sent to the customer.

For its main functions—calculating, accumulating and printing—the Post-Tronic employs established electro-mechanical principles. What distinguishes it from previous machines of this class is that some of the operator's work is taken over by an ingenious 'memory' system. Certain facts are stored magnetically on the back of each statement/ledger form. When the form is fed into the machine, these are picked up by electronic devices and passed to the mechanical part of the Post-Tronic; and before the form is ejected the magnetic information is automatically up-dated in readiness for the next posting to that account.

The recording system does not employ special characters of the E13B variety; the information is recorded in code on a series of magnetic ink stripes. It consists of the following items:

1. Last three digits of the account number.
2. Outstanding balance of the account.
3. Next printing position.

The value of item 2 is obvious; it replaces a keyboard operation and also eliminates pick-up errors. Similarly, item 3 ensures that the printing is done correctly without any attention from the operator.

The first item has even greater significance, because it helps to avoid the danger of an amount being posted to the wrong account, a major hazard in bank work, where account selection so often depends on the operator reading a nearly-illegible signature. The operator selects the account form in the usual way but simultaneously enters (through a special 'comparator' keyboard) the last three digits of the account number pre-printed on the posting voucher. These are then automatically compared with the account number stored on the back of the form. If they agree, the posting can proceed; if they don't, the form is rejected.

The memory system is also used for other purposes. Because of the magnetic pick-up, the taking of a trial balance is almost wholly automatic—the operator simply feeds the account forms into the machine, one by one. Similarly, the task of transferring the information to a new form at the end of the statement period is done without using the keyboard.

The Standard Bank's first Post-Tronic was delivered in April last year and since then it has been processing a section of the bank's current accounts; other sections will be brought into the system when the second and third machines are delivered early next month.

The total number of accounts is about 7,000 and, on an average day, between 3,000 and 3,500 items are posted to about 1,500 of these. In the past the work has been handled by 10 conventional keyboard accounting machines.

CHANGES MADE

The new system has enabled the bank to make a number of important changes in procedure, the over-all benefits of which may greatly exceed the savings directly caused by the higher rate of posting. One of the most important changes is that statements and ledgers are now produced at the same time. Previously they were produced in separate operations (a common banking procedure) to provide a measure of protection against mistakes in account selection and balance pick-up; and even then there was a chance of the same mistake being made by two different operators. The Post-Tronic, with its automatic verification and pick-up, eliminates such hazards.

Another major change is the introduction of 'deferred posting'—the day's transactions are now posted during the following morning. For this the Post-Tronic is not solely responsible, but as is so often the case when new equipment is installed the bank took the opportunity to make a 'reform' in procedure which had been under consideration for some time. Deferred posting has several advantages. It evens out the flow of work, ensures that the operators are fully occupied when fresh in the morning, and practically eliminates overtime. On these grounds alone, the Post-Tronic can be said to have raised morale in the ledger section of the Standard Bank!

The bank has also welcomed —not without certain misgivings —the opportunity to eliminate narrative descriptions from customers' statements. This obviously saves machine time and simplifies the training of operators. The misgivings arose because narrative is a bank tradition, and there were fears that some customers would be confused or annoyed by its disappearance. Therefore the bank took steps to provide *more* detailed information than before. The Post-Tronic prints a two-letter identification against each line of entry on the statement and to amplify this the customer is also sent the original posting voucher —after it has been microfilmed for the bank's own records.

The biggest change is concerned with the numbering of accounts. Here, the bank is definitely planning ahead; and it has made sure that its system will satisfy any further developments in automation. The main features are:

1. Accounts are in numeric and alphabetic order. This is achieved by allocating numbers on a 'block' system, with gaps large enough to accommodate further insertions.

2. Each account number consists of six digits, plus a final check digit representing the result of certain mathematical calculations on the others. It is thus possible to verify any account number by repeating the same calculations. The numbers used by the Standard Bank were supplied, complete with check digits, and will permit automatic verification when special listing/verifying machines are made available in Britain—a further example of the bank's policy of looking ahead.

NUMBERS FOR CUSTOMERS

The next stage in the development of the new system was to make arrangements for account numbers to be placed on all posting media. This was a formidable problem, complicated by the fact that about 40 percent of the postings are concerned with items other than customers' own cheques. But in spite of certain misgivings at the start, the stage has now been reached where 99 percent of the vouchers are 'personalised' before they reach the ledger department.

All head office departments have co-operated in this operation. Initially they supplied lists of the accounts with which they were concerned. To these the ledger department added the account numbers shown on the master list.

For the 'personalisation' of cheques, the bank uses addressing machine plates of the embossed metal variety. There is one of these for every customer covered by the Post-Tronic system. The plates are stored in special racks which facilitate selection; indeed, the 'personalisation' method is so quick that a customer asking at the counter for either a cheque book or loose cheques is normally supplied within a couple of minutes. In future all cheque books will be personalised before they are issued.

The same plates are also used to personalise the paying-in-books issued to customers. Payments made by post are accompanied by a three-part form, one part of which is an acknowledgement; and when the acknowledgement is returned to the customer the bank now encloses a supply of personalised paying-in slips.

For some months the first Post-Tronic has been doing the work of four conventional accounting machines. This, however, has involved a certain degree of overloading and the bank thinks that a more realistic ratio is 1:3.

A test carried out soon after the machine was installed revealed that 2,354 postings, with an average of one pick-up balance for every three items, were completed in a seven and a half hour run. Subsequent experience has confirmed that on straightforward work a speed of 340 postings per hour can be maintained without undue strain on the operators. In addition, the daily balancing routine has become little more than a formality.

The Standard Bank has planned its staff requirements on the basis of two girls to each Post-Tronic. One operates, while the other does such jobs as sorting the posting vouchers and returning the ledger/statement forms to the files after the postings have been made. Periodically they switch jobs—the bank finds that this practice pleases the girls and also prevents the posting speed from falling off as the day progresses.

The training of operators is much simpler than before. Because the Post-Tronic is very easy to use, it was possible to start productive work, with unskilled operators, immediately the first machine was installed. One of the best operators at present is a girl who 'could not even recognise a cheque' when she joined the bank a short time ago and had no previous experience of machine accounting.

A Decade of Work

Keith Bean

By the time their computer starts work next year Commercial Union will have behind them nearly ten years of planning. What do they hope to harvest?

A SIGNIFICANT virtue inherent in introducing electronic data processing is that it becomes practicable, if you have the head for it, to visualise all the results needed by a business and then to set out to get them all practically instantaneously. With this approach many old departmental boundaries may crumble and disappear yet there will be greater logic in the way things get done and, the business will take on a more orderly appearance.

'We started thinking on these lines in 1953,' says Mr F C Knight, manager of the mechanisation department of the Commercial Union Assurance Company, 'and so, with the delivery of our English Electric KDP 10 due in January, 1962, we shall have something like ten years of effort to show before the first button is pressed.'

Commercial Union has five million policies, most of these annual policies, covering fire, life, accident and motor insurance. Most of the company's business is handled by autonomous branches—over a hundred of them—each responsible for administering its own territory, including most of the policy issues and claims settlements.

The company made its first decision to go for large-scale mechanisation in 1953, using punched card equipment. The keyword from the start was integration, and the punched card system was planned as a move towards electronics. Besides embracing fire, life and accident business in one combined system, it united into one operational entity all the widely different companies which formed the group, augmented in 1959, of course, by the purchase of North British and Mercantile.

'When it was completed at the end of 1959 the company processed an operative fully integrated system,' explains Mr Knight. 'And we knew what we wanted in an electronic system and what we had been prevented from doing because of the limitations of punched card machinery.

'We set out our needs clearly and concisely on paper, including the quantity of data to be processed which permitted calculation of machine time for the work, had lengthy and fascinating discussions with various manufacturers and chose the KDP 10—fast, fully transistorised, with a core store for memory and data processing operations and with records on magnetic tape.'

Some of the planning principles that guided Commercial Union included:

—They would need a fully integrated system to do all routine work, to make all the rule-of-thumb decisions with 100 percent self-checking accuracy.

—Reference to officials was to be minimised—and always fully documented to aid speedy decision. Management was to be by exception rather than by mass inspection.

—Flexibility to accommodate all reasonable and foreseeable special requirements.

—No random access—any information likely to be needed was to be automatically provided in advance during other work.

—Data to be accepted by the computer in any order on arrival.

—Data preparation, wherever it might be done,

should involve no more than a single set of key taps on a typewriter or punching machine.

—New policies were to be issued daily, with other work on a five-day cycle. (Future machine improvements may bring this nearer a daily cycle but that is not essential.)

—All output needed for printing, etc, to be taken off during the daily updating run of the main computer records to eliminate the need for more than one run.

'The vital and most important stage of both operational planning and effective operation is the preparing of data for the computer,' says Mr Knight. The traditional method involves three sets of key taps—by a policy typist, a punch operator and finally a verifier operator—and is accordingly expensive.

A cheaper way is to use paper tape—punched at the same time as the policy draft form is typed—for the initial and only recording of data and use this tape (transmitted by Telex from branches to the head office computer centre) to prepare the document and as input to the computer. This is what Commercial Union plan to do. Similarly for cash data, the detail cash books will be typed instead of hand-written, thus producing a paper tape as a by-product.

SYSTEMS ESTABLISHED

Although it is still some time before Commercial Union take delivery of their computer—it is to be installed at a special data processing centre outside London—the way the main jobs will be done on the machine is by now fairly well established. Main master magnetic tapes will hold all known information for each policy, each agency, inspector, branch, each company, and the aggregations of figures arising—a total of some 1,600 million characters.

There will be a tape for each particular branch (or, in some cases, for parts of a large branch), permitting the choice of branches for processing—which can be important if there are local transmission delays. Each branch tape will be self-contained with its own control figures zero balanced, so that processing of a reel, taking four or five minutes, may be computer-checked for accuracy before processing of the next branch begins.

The order in which data are recorded on the master tape will be particularly important to efficient processing. For each branch all items will be in agent groups, mainly because the major printing jobs are to be in agent order. Within each agent group policies will be in policy number order irrespective of renewal date, type or other factors.

A novel feature of the Commercial Union system will be the association of permanent records and accounting records on the same tape.

This will reduce the total number of characters that need to be recorded since the conventional separation entails repetition of agent number, policy number, name of insured and name and address of agent in two places. It will have the further advantage of facilitating the simultaneous use of both types of information. For example, when renewal documents are to be printed from the record of permanent information, the branch could be told of any unpaid premiums and of claims recorded, and this additional information can be valuable.

The whole of the Commercial Union's work is to be accomplished in two main processing runs, so the system will work as follows:

Punch paper tape at branch and transmit by Telex.

↓

RUN 1. Take in paper tape.
Apply data checks.

Output three magnetic tapes:
- Tape 1: Queries — print and issue.
- Tape 2: New policies—print and issue.
- Tape 3: Checked and sorted movements.

↓

RUN 2. Feed in Tape 3 with the main file tape.

↓

Proceed with updating, applying further data checks.

↓

- Tape 4: New updated main file tape.
- Tape 5: Queries—print and issue.
- Tape 6: Renewal reminders; Declaration reminders; Maturities; Outstanding claims; Transfers to next input — print and issue.
- Tape 7: either Data for printing renewals or Data for printing accounts.

Output further magnetic tapes

MECHANISATION BY PAPER TAPE MACHINES

MANY insurance companies still do not see their way to purchasing a computer; there are alternatives to buying a machine outright—such as shared purchase or using one of the computer service bureaux. One alternative is to adopt a really different approach to mechanising insurance data processing work by employing multi-purpose paper tape machines such as Flexowriters.

Some 20 insurance companies now use Flexowriters, including Crusader, National Provident, Beacon and Cornhill.

The Crusader application was initiated five years ago on the dual plan of using the machine to the maximum for policy writing while planning for its use in preparing additional tapes for a tape-to-card translator for a computer with 80-column card input. It has been described at such length that it has some of the aspects of a classic in the insurance world.

A more recent installation is that of the National Provident Institution for Mutual Life Assurance—a life office with nearly 100,000 policies — which took delivery of two SPD Flexowriters with auxiliary punches punching 8-channel tape in 1959. Policy forms and record forms had been re-designed—so that the information they contained was in the same sequence in the policy and in each record relating to the policy—and a number of programs had been written and tested before normal production began.

National Provident began working with these machines as follows: the first operation was to type a summary sheet containing all the information required for the individual policy and at the same time to record that information on paper tape. During this operation the machine was controlled by the initial program tape which not only provided the spacing and carriage movements necessary for the summary sheet but also inserted into the data tapes the machine control codes necessary for producing the policy and record forms required for that type of policy. One initial program was required for each type of policy (endowment, whole life, child's deferred and so on), the 'type' program assisting in automatically producing the individual data tapes for each policy. (The summary sheet provides the basic record to file with the papers of each record.)

This program tape was fed into the machine so that the summary sheet could be typed and during this process two secondary tapes were produced (one of the main punch and one on the auxiliary punch). These tapes contained not only the information typed on the brief sheet but also the programming codes passed through from the initial program tape.

The summary sheet was then thoroughly checked and any errors shown up necessitated scrapping the two secondary tapes and starting again.

When the summary sheet was correct, one of the secondary tapes was used to print the policy, during which operation two further tapes were produced—one for an alphabetical index card with brief particulars of each policy and the other to produce a general policy record card which would be filled in numerical order of policy number.

Similarly, when these later records were produced, further generations of tape were punched

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Cycle working is to be employed in two ways. The main updating run (Run 2) will handle part of the main file each day—on a five-day cycle with 100 branches this will mean the records for about 20 branches. The main tapes for those 20 branches then will remain unchanged for four days. All incoming data is to be processed daily on Run 1 but data for branches where no up-dating is due that day will be stored until the cycle time comes round.

Processing for cash—premium payments and refunds and settlements of commission—is the most difficult problem in designing a computer system for an insurance company. In Britain 75 percent of premiums come in account settlements from agents and the rest direct from policy-holders or through banks. Quite a quarter of payments do not match the amount of the unpaid item recorded in the file. Commercial Union has therefore evolved a simple form of editing cash data which can be applied by the cashier who receives the remittance, and which is neither difficult nor time-wasting.

Printing and issuing of renewals will be the largest single production operation. Practically all policies have to be renewed once a year, while many require half-yearly, quarterly or monthly renewal—up to six million renewals a year. Each agent receives a monthly issue of renewal documents.

For legal reasons it is not possible to use a common renewal form for each class of policy. The minimum is about six, increased in the motor field by the need for the appropriate variety of Motor Insurance Certificate.

DUAL-PURPOSE PRINTERS

Since Commercial Union decided that all renewal documents must be produced in complete agent order ready for issue in window envelopes and must therefore be printed in agent series irrespective of different wordings, there was only one answer—to use Xeronic printers.

These printers can print on to completely plain

which produced the actuarial valuation card from which were compiled the records for the valuation of the liabilities and a ' punched card ' tape to which reference will be made later.

The valuation card was a visual card, not a punched card, which was previously hand-produced, the advantage being that this record now contained the information which was in every other record (already checked) reproduced mechanically and therefore not subject to human error.

The second tape produced from the summary sheet typed a renewal card for the collection of premiums and a list for the information of the agency department.

Producing the initial program to deal with all these forms was a lengthy undertaking and even a minor alteration in one of the later forms caused considerable alteration in the initial program. The introduction of a new auxiliary machine, Selectadata, offered the possibility of simplifying the programming considerably.

The Selectadata is, in effect, a second reader which can be set to search a paper tape at high speed until it reaches a certain address code. It can be instructed, having found the address, to print out the information following it and then return the control of the tape to the main reader.

The initial program needs only to position the machine for typing the summary sheet and at the same time to punch out address codes before each piece of information on the summary sheet.

For printing a policy, a policy program tape is used in the main reader of the machine and the data tape produced from the summary sheet is inserted in the Selectadata. The policy program tape positions the carriage and instructs the Selectadata to search for the address code corresponding to each piece of information required. When the address codes are found, the relevant information is printed on the policy.

Similarly a separate program can be made for each of the other records.

This saves programming complications. It is easier to make minor adjustments in form layout. It saves a considerable amount of paper tape. Records can be produced in any order. And it is easier for the operators to handle.

National Provident therefore dispensed with their auxiliary punches and substituted Selectadata. A third Flexowriter was introduced and one machine prepares summary sheets while the other two produce the policy and office records. About 80 percent of the company's policies are now produced thus and programs have been written for further types of policy, but have not been used because the machines are already fully occupied.

During the introduction of this system National Provident had decided to instal ICT punched card equipment. Programs were therefore written with a view to producing a ' punched card ' tape containing information for the various punched card records which would be set up.

With a tape-to-card converter the cards are thus produced without human copying processes.

' There are many other uses to which the Flexowriters could be put if time allowed,' said Mr C A Gates of National Provident. ' One application introduced is printing credit slips for payment of salaries direct to the bank. A paper tape contains an employee's name, his bank and its branch and it only remains for the operator to fill in the amount each month. While the slips are being typed a further tape is made including the amounts and this is used to prepare a schedule for the paying bank and for internal purposes.

' Three young operators were recruited and they quickly learned to control the Flexowriters. It is difficult to estimate staff they have replaced because previously many people had been employed for part of their time on some small fraction of the procedure.'

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paper words, figures, lines and crests in two ways simultaneously—background wording by microfilm and individual names, premiums and so on by cathode ray tube display. The machine can print selectively many different kinds of form on each run. Microfilms are so mounted that the form background can be switched from one type to another by signals from the computer. At the same time all data for insertion is computer-signalled on to a cathode ray tube, the two displays being carefully synchronised and aligned to produce a complete but hybrid print.

After printing the forms will need no collating, but merely cutting and putting into window envelope dispatch; even the cutting marks will be printed on the paper under computer control to achieve exactness. The printer will use forty feet of paper a minute—printing about 4,500 renewals an hour. All Commercial Union's printing is to be off-line so that the tapes can be fed to two printers and neither computer nor printers will be held up by machine stoppages.

The printers will also produce, of course, monthly accounts, statements for each agent, results of pre-renewal file examination (a month ahead), new policies, endorsements and management control figures as required. The furnishing of name indexes to branches is also likely to be easy to do by computer—by the monthly printing of registers (like telephone directories) of policy-holders and agents with detail of policies. Normal card index or strip index maintenance is time-absorbing and prone to produce errors. Registers with such frequent re-issue need no maintenance at all the branches.

Summing up on Commercial Union's proposed computer operations, Mr Knight declares: ' The effect of using a computer in this manner will be to limit the work of clerical staff to what is of first importance—public relations service. Branch staffs will be able to concentrate on interviews and correspondence connected with arrangement of policies, settlement of claims, disposal of queries and provision of decisions and advice.'

READER ENQUIRIES
MACHINE AGE
The international industrial newsmagazine
The readers on the attached cards have requested further information on your company's products or services detailed below.
Item
DO NOT DETACH THESE CARDS UNTIL THEY HAVE BEEN DEALT WITH
47 DONALD McINTYRE, ORCHARD PRECISION ENGINEERING LTD. TORONTO 3, ONT. CANADA.
MACHINE AGE ENGLISH EDITION
READER ENQUIRY

Punched cards put advertisers in the picture

Enquiries are recorded on cards, sorted quickly then passed on to the people they concern

TODAY, in the engineering fields of instruments, control and electronics, products offered on the market are becoming so numerous that the technical journals which cover these specific fields have to disseminate a vast amount of technical information about new products. Both in the editorial and the advertising pages of these publications it is practically impossible to find room to publish every detail of a new product that a reader may require. To get round this difficulty technical publishers endeavour to provide a service to bring reader and manufacturer in touch with each other quickly and without lengthy correspondence.

One publishing company, Rowse Muir Publications Ltd, who publish the three journals *Control*, *Nuclear Power*, and *Machine Age*, have—in company with their peers and equals—adopted a readers' enquiry service. Reply-paid cards, on which readers can indicate those items on which they require further information, are bound into each copy of their journals. These cards are now being used more and more, particularly by overseas readers extending from Europe to the Far East.

All editorial descriptions of manufacturers' products and all advertisements appearing in the journals carry code numbers. Similarly those issues which include a buyers' guide have a code number against each main heading of the guide.

The enquiry cards are printed with the same set of code numbers and it is only necessary for the

A punched card, duly 'interpreted' to show the name and address of the enquirer, and an explanatory leading slip are sent to the manufacturer. This system could be adopted by other organisations than publishers: for example, a mail order firm selling from a catalogue to communicate to various departments orders received

reader to mark off the numbers of the items (which may be several) in which he is interested and post the card off to the publishers.

The processing of a few cards could be done manually but it would be tedious, slow, and liable to those inaccuracies which can lead to inconvenience or annoyance to reader and manufacturer alike. When, however, the enquiries approach something like 2,000 items a day other methods become essential, and Rowse Muir have evolved one that comprises the use of ICT punched card machines.

Punched cards are usually associated with large complexes of equipment which are expensive to buy or hire, and whose kingpin is usually a tabulator. In fact cards are merely a convenient medium for holding information which may have to be presented in more than one form or sequence, and the processing of cards may require no more than two machines. Certainly a card installation need not always imply having to employ several skilled operators.

ONE GIRL ONLY

Rowse Muir's system is not complex and the machine work is handled by only one girl operator.

Her first task is to make punched cards to correspond with the enquiries received on pre-paid cards.

In the case of straightforward editorial or advertisement enquiries, the operator punches a card with the code number of the editorial or advertisement, the name and address of the enquirer, and the issue number of the journal. This is an operation very similar to typing and involves no more work as the operator merely depresses the appropriate keys and the machine, an ICT model 29 automatic key punch, looks after the card feeding and punching.

When the enquiry covers a number of items and most of them do, further cards are punched but only with the item code numbers as the reader's name and address can be produced from the first card by a second machine. This reduces the punching time considerably.

LISTS OF MAKERS

Buyers' guide enquiries are treated slightly differently. Here one code number will represent not just one manufacturer but a number who all offer the same product. Thus for example, 201 may be Transducers, 104 Air Compressors, etc. In these cases the punch operator refers to a list of manufacturers under each code number and if there are five producers of Transducers, five cards will be punched, each carrying a separate manufacturer's code number.

As the punched cards are to be sent out to the manufacturers who will not be able to read the perforations they are first 'interpreted.' This is done on an automatic machine which reads perforations, translates them into normal language and prints out the interpretation on the card.

At this stage the cards are available for the production of statistics and by coding the cards it is easy to count—in the sorting machine—the number of enquiries from each country or from each status of enquirer.

The cards are punched in random order and are next sorted on another machine which feeds 36,000 cards per hour. This machine brings together all cards with a common manufacturer's number and such numbers in numerical sequence. Thus if there have been six enquiries from various parts of the world about one product, the corresponding cards will now be together.

The cards relating to different journals or the buyers' guides are kept separate during all the operations so that the manufacturer can easily identify the publication which has produced the enquiry.

To make the matter clearer to the manufacturer, a 'leading' card (printed with the name of the journal concerned) is next made out with his name and address, a description of the item in which the reader is interested and the reference number and issue of the appropriate journal. The punched cards are finally stapled to the leading card, inserted in a 'window' envelope, and posted to the manufacturer.

The great advantage of this machine procedure lies in its speed, as enquiries can be passed on to the manufacturers far more quickly than is possible with manual methods. In fact on most days the enquiries can be processed and posted out on the same day.

The service is also of benefit to manufacturers as, apart from providing tangible evidence of the efficacy of advertising, the cards form an easy medium for advising the department or overseas branch of an interest which warrants attention.

SURVEY PART VI

Tape-Preparation Systems

PAPER tape is an important medium for handling information both in communications systems and in business data processing: it is used increasingly in teleprinter systems and in computer installations, both as an input and output medium in conjunction with paper tape readers and punches. Probably the cheapest of the machine data—it costs about 3/6 per 1,000 feet—paper tape has certain advantages over the other principal computer information medium—the punched card.

Yet whether paper tape is used in communications systems or as the input medium for a computer it has first to be encoded. There is a wide range of machines designed to encode—or punch holes into—paper tape, and this section of the survey reviews all the known devices for putting information into paper tape.

The paper tape used in normal teleprinter operations employs a code comprising combinations of punched holes over five tracks or channels: this gives only 32 possible combinations (and theoretically should give only 32 alpha-numeric characters) but, by adopting a system akin to key shifting with a typewriter, 52 alpha-numeric and other characters can be obtained. These include the 26 letters of the alphabet, the figures 0-9, and sixteen punctuation symbols. In addition, provision is made for six instructions (space, figures, letters, line feed, carriage return and blank) making a total of 56 characters in all.

For data processing purposes punched tape is required to have a checking channel, so if five channel tape is used one of the channels is utilised. However, tapes with six, seven and eight channels can be used which give additional facilities—for characters in upper and lower case, etc. Each column of holes across a tape holds one alpha-numeric character, and a standard tape has a capacity of 10 columns to the inch, so a complete set of variations can be accommodated in four inches of tape.

The use of eight-channel tape for data transmission (instead of the conventional five-channel tape) is a new idea, and one which is being worked on by a number of companies notably ATE and Bendix Ericsson. Clearly, employing eight-channel tape for this purpose would have important advantages—with eight channels 256 combinations of holes (or characters) as opposed to 32 can be recorded on paper tape.

There are numerous ' hole codes ' for paper tape in use—the International Telegraph Code, the Ferranti and Ferranti Pegasus Code, Pure Binary Code, and Binary Coded Decimal, being the most widely used. Several manufacturers, notably Olivetti, have their own codes; these are usable with their own equipment only.

There are many ways of preparing paper tapes —encoding them with information, but—for convenience—they may be grouped into three main categories: *primary tape punching*, where information from an original document is transferred to paper tape by a manual punching operation; *by-product tape punching*, where tape is produced on a cash register machine, an accounting machine, or some other printing machine as a by-product of some keyboard operation which is devised to produce ' hard copy ' ; and *secondary punching*, where the tape is produced from primary tapes after some verifying or editing operation.

PRIMARY PUNCHING FROM SOURCE DOCUMENTS

Manual entry

The manual perforating punch is used in many computer applications to convert information in source documents into a machine-usable form.

The punches are standard, but can be modified in detail to suit the needs of the particular computer or communications manufacturers who incorporate paper punches into their system.

The Creed 7 P/N Keyboard Perforator is the standard model tape punch in this country. This punch measures some 24 inches by 13¾ inches by 15½ inches high and weighs 47 pounds. The keyboard perforator comprises a teleprinter-type keyboard with the full range of alphanumeric keys, a perforator unit for punching the tape under control of the keyboard, and a motor for activating perforator control and perforator units.

The tape from such manual punching is usually passed to a tape verifier for checking to produce an ' edited ' tape.

When the operator depresses a key the appropriate code combination is selected, the selector bars are positioned between the punches, the code combination is punched into the tape. A back-space key allows the operator to correct errors detected in tape preparation, and an end of line indicator lamp tells the operator to depress the carriage-return key. Automatic high speed repeat punching of any character is possible through depression of a run-out key. The cost of the 7 P/N is £132 and the delivery time from three to seven months, depending on the special facilities and quantities required.

BY-PRODUCT TAPE PUNCHING

Point of Sale Punching

The Sweda Register with tape punch attachment

This is manufactured by Sweda Data Register AB of Stockholm and marketed in Britain by London Office Machines Ltd.

An ordinary Sweda cash register is fitted with a special appliance on the left-hand side of the machine. As the operator puts the tape spool into the punching appliance the identification number of the machine is automatically punched on the tape. This number is also punched automatically when tape is taken out of the appliance, serving as a security device.

The operator can adjust operational modes on the register to record all information, *ie.* department (specified by numerical code) salesman, type of sale (cash or charge) price and item number. Or else she can record select data: stock item number and selling price (for merchandising control) or a customer number and amount.

The tape punched is five-channel, four channels being for information and the fifth serving as a parity check. Twelve characters of information are block-punched simultaneously to make a 'word', 10 codes being variable information, and two fixed information codes. If the information is too much for the 10 codes provided, a second ' word ' will be utilised making a ' sentence ' of 24 characters. Punching is done according to a binary ' odd code ' the value of every code hole being determined by the channel into which it is punched. When the number of holes punched in the channel is even a fifth check hole is automatically punched. Up to a maximum of 16 symbols are included in the tape; three fixed program instructions (one a machine identification) and a variable number of instructions can be entered in code via the keyboard.

The speed of entry depends on the operator but is reckoned to be about a 10 digit word every second. Punching is about 10 characters per inch.

The tape produced is taken from the register (and automatically punched with the machine number on removal) and passed for processing to a computer or punched card installation, via a tape-to-card converter.

The National Sales-Tronic connected to a Model 461-2 *Tape Recorder*

The tape punch 461-2 is an independent unit and can be cable connected not only to the Sales-Tronic, but also to the NCR 31 accounting machine (see below). The two models of Sales-Tronic 6000, and Class 21, can both be linked to the recorder. At present applications of NCR registers linked to tape punches are confined to the USA.

The tape punch is a free-standing unit 9½ inches high by 13 inches wide and 13 inches deep. It can be sited up to 500 feet from the point of sale machine, or can be located in the typewriter well of a desk or below a sales counter. It consists of four plug-in assemblies, diode control board, punching mechanism, relay assembly, and stepping switch.

The control board determines what program shall be used; eight programs, can be used with a maximum of 38 characters per program. It also determines what symbol code shall be used, since the punch is universal, *ie.* able to punch all known codes, and to accommodate 5-, 6-, 7-, or 8-channel tape. The machine can be programmed to punch zeros automatically; also store branch or transaction numbers can be recorded automatically, as specified by the program. All the codes are provided with odd or even parity checks as per program.

Punching is activated by the keyboard of the Sales-Tronic, and provision is made for time-sharing, *ie.* the recorder will be punching the data on one transaction, while the operator is recording the next transaction. An ' answer back ' checking circuit ensures that digits are correctly positioned, and if not, the machine is frozen. Other security checks allow for the stopping of the machine automatically, 25 digits ahead of the punching head, when the paper tape breaks; and for signalling by a light on the keyboard when paper tape is running out.

Tapes from accounting machines

As stated above, the NCR data recorder can be cable-connected to the National 31 accounting machine as well as to the cash register. It can also be connected to the smaller National adding machine rather on the lines of a manual punch in the computer installation. But this is not the only accounting machine range to make use of tape as a by-product of their hard copy transactions. The Burroughs Sensimatic F 1000 PA is designed to operate in conjunction with A 520 tape perforator. The Olivetti Audit 322 accounting machine is equipped with an alpha-numeric tape punch inbuilt into the model. Addo also have a number of accounting and add-listing machines which provide a punched tape output.

The Burroughs Sensimatic linked to a tape perforator

All the models of the Sensimatic range can be geared to take the tape perforator, the numeric as well as the alpha-numeric. In a typical installation, the F 1000 PA alpha-numeric punch would be integrated with an A 520 tape perforator. The perforator, whose dimensions are approximately 12 inches high by 8 inches wide by 7 inches deep would be generally attached to the stand of the accounting machine though it could be remotely situated if required. The control of exits from the accounting machine and entries to the punch is vested in a single plugboard, situated to the rear of the machine stand. The various calculation phases, as well as the punch, non-punch, routines are controlled by the four-schedule control centre, the ' mechanical ' plugboard. The selection of posting and punching programs is thus controlled on the Sensimatic by the program selector knob. The tape punch control keys—for punching, feeding tape, tape error and starting and stopping the punch are situated on the Sensimatic keyboard to the right of the numeric keyboard. Warning lights (for power on, punch on, low tape supply and exceed capacity) are provided to signal to the operator visually. 26 letters, 10 numerals, and codes activated by the special character keys can be punched into the tape.

The Sensimatic/tape perforator is able to produce tape for both communications and data processing, and can be programmed to take 5-, 6-, 7-, or 8-channel tape. If 5-channel tape is used FIGS or LTRS codes are automatically punched. Both alphabetical and numerical data can be punched, as well as fixed data, date, identification number which can be punched automatically. Zeros are programmed to be punched automatically, including zeros for preceding digits to complete field capacity. Eight punching programs are available, with eight additional programs possible; random access is possible to up to 18 memory units by automatically punching the memory identification number beside the amount.

All possible code combinations are available for programming, and thus any standard code can be utilised. Additional programming flexibility is possible through the wiring transmitting signals from keyboard to the plug-board control exits, from carriage position, motor, location of first significant digit, etc.

The checking facilities on the tape include parity checking to ensure valid codes are punched and ' echo ' circuitry to ensure all codes are punched. The usual mechanical working checks are available.

The Addo-X book-keeping and add-listing machine with intrgrated tape punch

The Addo-X machine is a relatively unsophisticated add-listing machine which is nevertheless able to carry out a very vital function in the field of computer input. It is able to act both as a manual punch and also as a reader-punch summarising and editing data, and checking data received over telegraph wires.

This Addo machine has a numerical keyboard only, with 12 numerical symbols (0-11) and five instruction symbols. Punched tape readers with their own decoding units and power supply, with capacity for 5-, 6-, 7-, or 8-channel tape can be linked to the accounting machine via a solenoid. So can a high-precision tape punch, again with a capacity of 5- to 8-channel tape punching. The tape unit is a self-contained unit with keys for on and off tape feed, and tape erase. It incorporates scanning equipment, encoding unit power, pack, paper punching unit, and program unit.

The program unit is under the control of a plastic punched card which is inserted by the operator, and changed when the punching program needs to be modified. The pre-determined program can control codes punched after each group to ensure carriage return and line feed.

The codes punched can be of any of the standard codes: Ferranti, International Telegraph, etc, and both parity checking and the use of control totals can be incorporated. Any program instructions

and any number of letters and symbols can be included, subject to the customer's specification.

The Addo-X machine therefore not only serves as a manual tape producing device; if a reader is attached to the machine in addition to a punch, it is also possible to take a large number of short tapes from a number of sources, amalgamate and summarise them to produce a continuous ' edited ' tape.

It will be seen that this method has great versatility and a wide variety of applications. The cost of these machines varies from £950-£1,370, depending on the model of Addo Machine, and delivery is given as two to nine months.

Mercedes Sterling Accounting Machine with inbuilt tape punch

Mercedes Sterling accounting machines can be fitted with automatic tape punches, the control bar of the machine selecting what items should be punched and which ignored. The tape unit is inbuilt into the left-hand side of the accounting machine and has the capacity for either 150 or 400 metres of tape on the tape spools. The punching device has a positive mechanical action from an electrically driven rotating shaft.

The machine is able to punch 5-, 6-, 7-, or 8-channel tape as required. Both numerical and alphabetical information can be punched, when 5-channel tape is used the operator has to depress the appropriate ' Lt ' or ' Fi ' key on the machine to type letters or figures. The machine is able to accommodate any known code and program instructions may be included on the tape.

The machine programs may be varied by altering the control or program bars. The machine has the usual check features, such as warning lights that tape is being punched, and that the tape is coming to an end.

The machine costs from £1,000 to £2,500, depending on the number of totalisers and other features. Delivery time is given as four to six months.

The Olivetti Accounting Machines with inbuilt tape punch

There are three models of accounting machines in which tape punching facilities have been incorporated. These are the Audit 622, described as a desk based machine with integral punch for numerals only; the 722 and 732 models, which punch both alphabetic and numeric codes, the latter machine being slightly more versatile.

The punch unit consists of a coding unit—which converts data into a six-channel code—a punching unit with a punch for each channel activated by a coding unit, and a feed mechanism. Tape punching is done simultaneously with writing and posting; punching instructions are automatic and issue from the program bars.

The punched tape produced is six-channel only and has the characteristic of Olivetti punching, square holes. At the moment the tapes are utilised for data processing only, being incompatible with ' slow transmission teleprinter systems.'

Special fast reading six-channel codes are used, covering the full alphabet, numerals 0-9 (10 and 11 for sterling machines) error codes for both numerals and letters, full stop, space and other service codes. Parity code digits are apparently not required because of the direct mechanical exchanges between machine and punch.

Automatic interlocks safeguard punching by causing the machine to lock when spool is nearly empty or overfull or when the tape breaks or tape is incorrectly laced.

The FME Supermetall Accounting Machine with connected punched tape output

Another accounting machine which is now being introduced in this country is the FME Supermetall, a German equipment which is to be marketed in Britain by Broughtons of Bristol. The machine is able to punch five-channel tape, both alphabetical and numerical characters, and use the Decca punching code. The machine, which is able to subtract and multiply, costs from £1,200 to £3,000, depending on the registers and features of the accounting machine.

Typewriters that originate punched tape

Typewriters with tape preparing facilities can be divided into two major classifications; those without tape reading facilities, *ie.* those that rely wholly on the manual keyboard of the typewriter to enable information to be punched into tape; and the more sophisticated typewriter with tape reading facility (so that information punched into tape during an earlier operation can be read and automatically typed out while additional information can be keyed in via the keyboard.

In addition some equipments have auxiliary reading devices which allow for a tape and a program tape controlling operations (printing, punching, etc) to be run in parallel with a punched tape output as a by-product.

Into the first category come the Mercedes Sterling typewriter punch, the Olivetti typewriter punch, and the VEB Supermetall Portable typewriter punch. Into the second category come the Creedomat of Creed and Co, the BIMA of London Office Machines, and the Flexowriter.

The Mercedes Sterling Typewriter

The Mercedes Sterling typewriter is an electrical typewriter with inbuilt punch located on the left-hand side of the machine. It is medium sized, measuring 24 inches by 24 inches by 12 inches high and costs between £630 and £650.

The typewriter punch is able to produce 5- or 8-channel tape, either alphabetical or numeric characters. In the case of 5-channel the ' Lt ' channel key is depressed for punching letter keys—the figure and symbol keys being thereby locked, while for figure and symbol punching the ' Fi ' key is depressed. A program bar can be fitted for selective punching of data, though automatic zeroing or decimal tabulation is not yet possible.

When the carriage return bar is depressed the keyboard locks, following the punching of the opposite symbol, and the operator has to depress space symbol key to allow punching to be resumed. Other warning checks are the locking of keys and control features when the motor is switched off, and the signalling of ' tape low ' by a red light.

The typewriter can be used for both data and communications work since it can utilise the International Teleprinter code as well as any other known code.

The Olivetti Typewriter with built-in tape punch

The Olivetti Audit 930 is also a manual punching and typing system, without tape input. Like its counterparts it punches only six-channel tape with square holes using the Olivetti alpha-numeric code. Like them its operation is controlled by a program bar, and auxiliary instructions and device codes can be punched into the tape. The typewriter, which will be marketed early in 1962, with the other Audit equipment costs £540.

The Supermetall Portable with Tape punch

The Supermetall typewriter coupled to a tape punch, like the FME accounting machine, uses the 5-channel Decca alpha-numeric code. The machine which has a delivery period of 3-6 months, is marketed by Broughton and Co at a price of £450. The machine is able to use the 5-channel international code and is thus able to be used for communications as well as data processing.

The Creedomat

The Creedomat is a combined equipment consisting of an IBM electric typewriter interconnected with a Model 25 tape punch and Model 92 tape reader. In this way hard copy may be produced, for multi-copy invoices, etc, and all or selected portions recorded on the tape in upper and lower case.

The equipment may punch out 5-, 6-, or 7-track code. With additional facilities the tape can be revised, corrected and duplicated. Any standard codes can be used.

The reading facility allows for tape prepared either on this or other machines to be converted in hard copy at a rate of 100 words per minute. A further by-product tape can be produced from this operation.

The complete equipment, which is desk-mounted and measures approximately 42 inches by 24 inches high, is priced from £1,250 depending on facilities.

The BIMA Typewriter with tape producing facilities

The BIMA, which is marketed by British Equipment Company Ltd, is a composite equipment consisting of an electric IBM typewriter linked to a tape reader and tape punch. It can thus generate its own tape by keyboard operation, or may produce a by-product tape by a combination of manual typing and reading of a pre-punched tape. The equipment utilises either 5-, 6-, 7- or 8-channel tape, and is able to utilise all the letters, upper and lower case, numerals and symbols of the 44-key keyboard. The codes can be international 5-channel Ferranti, GEC or any other standard British code. Vertically programmed instructions can be included on the tape, when a by-product tape is being punched under control of the reader-punch. The machines are fitted with start-stop punch instruction device for duplication of tape or preparation of by-product tape, a non-print device allows tapes to be used for data processing, and a tape skip device allows individual items to be selected from the tape at 25 codes per second. Punching can be automatic, controlled by codes in the tape being read, at 600 codes per minute. Manual operating controls are on the keyboard below the typewriter.

The BIMA models vary in price from £1,500-£3,000 depending on features incorporated. There are several models designed for particular jobs. The delivery time is some three months.

The Flexowriter SPD with tape input and tape punching facilities

This is a data processing system allowing for two input media, a program tape and a tape prepared from a previous punching, and three output media, hard copy on the typewriter keyboard and two tapes, incorporating selected data. In this case an auxiliary tape punch is used.

The Flexowriter is able to punch 5-, 6-, 7- and 8-channel tape. Any codes can be utilised and a maximum of 86 letters (upper and lower case), and symbols, can be included on the tape plus addition ' compound ' codes giving a maximum of 256 code combinations. These redundant codes can be used to control other tape-operated office machines, and even computers. Both 5- and 8-channel data transmission systems have utilised this medium of tape preparation. An SPD model Flexowriter can be linked to a Tradan transmitter. This can be used to transmit selected data, entered on the keyboard or via edge-punched cards over telephone circuits to a remote Tradan receiver and Flexowriter. In 8-channel transmission, functional codes can be included to control remote tape punching.

TAPE PUNCHING BY TELEPRINTER

As stated, punched tape is used both as a means of data entry into a data processing or a computer system, and also for data transmission.

The Creed Model 75 RP with tape reading and reperforating punch. This equipment produces a 5-track punched record of outgoing messages, using the International Teleprinter Code, or other codes, simultaneously with the hard copy on paper.

For incoming messages—a tape is punched out automatically at a speed of 100 words per minute and acts as a record for all transmitted traffic. The punching device has the usual inhibiting safeguards for punching/reading, warning light for tape exhaustion, and back space facilities for operator errors. The hard copy serves to monitor the correctness of the tape punching.

The Model 75 RP, 16 inches by 13½ inches and 11 inches high, is the world's smallest teleprinter. The reperforating attachment is located on the right-hand side of the transmitter receiver. The cost of the machine is from £350.

Similar to the 75 RP Teleprinter is the PR 75 Printing Reperforator which transmits in the same way as a teleprinter, but prints out the character on the 5-channel punched tape itself between the feed-holes. This equipment costs from £325 (with keyboard). Two other models 85 and 86, also print out on the tape itself, the 86 punching out 5-track tape and printing below the punching, and the 85 which punches 'chadless' tape and prints out on the hinged chads. These equipments, which are slightly slower in automatic punching—66 as opposed to 100 words per minute—and slightly lower in price, cost £275.

VERIFYING PUNCHES AND EDITING EQUIPMENT

Before paper tape can be processed in a computer or converted to punched cards or magnetic tape, some form of tape editing or verification is necessary. It is reckoned that in manual punching one error occurs per 300-1,000 characters.

With the Ferranti Pegasus system, for example, there is available a full set of tape editing equipment consisting of teleprinter, with keyboard and tape punch; triple-headed tape reader; auxiliary tape reader, for simple printing and copying; a keyboard perforator, and power supply and control units. Modified standard Creed equipment is used.

Using this combined equipment tape can be prepared in parallel on the manual punch and on the teleprinter. A simultaneous print-out is obtained of the teleprinter punching, and the manually punched tape can also be read and printed out. The two tapes can be run on a comparator the triple headed reader with two channels for reading and one for teleprinter print out. This is linked to the teleprinter, so that a by-product tape and a print out can be produced simultaneously. The by-product tape continues to be punched out until there is a disagreement in the tape, when the machine automatically stops. The print out can then be compared with the original and the two tapes, to see which is correct. The correct tape is made the master for this particular operation, and then the comparing is resumed. Should any additional information be required this is put in by the manual keyboard on the teleprinter.

Checking original tape is done by visually checking the print out of the tape on the teleprinter against original copy. If an error is detected, the machine is stopped by the operator. The printing is inched back to the error, and erasures and corrections made on the teleprinter keyboard.

When tapes have been automatically copied there is less chance of error, so that two tapes can be run on the comparator without using print-out.

The code used in the case of the Ferranti installation is 5-channel tape with odd parity checking and 60 alphabetic/numeric symbolic characters. The binary numerical value of each letter is in the same position of that letter, *ie.* 00001 for A, etc, facilitating alphabetic sorting. Decimal digits have binary equivalents, though three are modified for the parity checking purposes.

Creed Reproducer System

For the reception and reproducing of tape from outstations, and editing and passing to a computer the Creed Reproducer set is used. This consists of a tape-reader 6S/6-M and Model 75 teleprinter with tape punch (reperforator). The 5-channel tapes from the outstations would be received on the teleprinter, checked visually and reproduced in tape form. In addition it can be used for tape transmission, storage duplicating and page printing.

This system takes up an area of 42 inches by 24 inches by 39 inches high, desk mounted with control unit built into the desk. It costs from £565.

Creed Model 90 Tape Verifier

For verifying tape produced manually a combined unit is used, whereby a tape punch Model 25, is linked up with Model 92 Reader and keyboard. This allows 5-, 6-, or 7-channel tape to be examined and a verified tape prepared without the original errors.

When verifying the keyboard, tape reader, and punch are so connected that if the combination for the depressed key corresponds to the characters sensed the reperforation operation is carried out. If not the keyboard locks and the operation checks

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Calculator is a life-saver

A new technique for giving radiation treatment was evolved, but it could never have got off the ground without the means of doing quickly the large number of calculations the technique entailed

Renault Capes

IN a modest corner of the Cobalt Therapy Installation at St. Bartholomew's Hospital, London, a small calculator has recently been installed. Costing £400, it ranks as a modest item in the unit, whose radiation equipment alone cost anything up to £35,000. Yet this machine—an Archimedes Diehl DSR—is of vital importance because on the treatment calculations made with it the whole structure of radiation dosage and concentration is based.

Cobalt therapy is a very new and effective method of treating malignant tumours, using a process of gamma radiation from radioactive cobalt. This treatment requires very precise control and timing—hence the requirement for a succession of fairly sophisticated calculations.

Until recently the treatment was given by radiating one or more fixed beams for pre-determined periods on the tumour, which is located by normal radiography. This method has the disadvantage that the dose of radiation used has to be governed by its effect on intervening tissues—in other words, a tumour may only be effectively dealt with at the expense of burning a patient's skin. As a result effective dosages of radiation could often not be used.

However, recently a new method, rotation therapy, has been evolved, to allow higher concentrations of rays to be used with safety.

Rotation therapy takes as its basic assumption the concept of the tumour as a complete circle with the nucleus of malignancy in the centre. The radiation instrument, a cobalt isotope fixed to a revolving head, rotates for a specified time at a fixed distance from the periphery of the tumour. In this way a higher concentration of rays can be beamed continually on the growth, and as the skin tissues are exposed to the beam for only a short time the radiation peril to the internal and external tissues can be ignored.

All this involves the correlation of several different factors: fixed beam radiation theoretically involves 36 beams 10 degrees apart, though the effective dosage may be considerably higher. But another factor occurs to complicate still further the calculation of the exposure and concentration figures. This is the shape and dimension of the tumour.

While the principle upon which the beam rotation theory operates envisages a perfectly round tumour with a central nucleus, it is obvious that in practice this can never be achieved. Tumours will be oval, oblong or practically any other shape; and it is rarely that the nucleus is centrally situated. So first the exact size and shape of the tumour must be calculated and planned. Then from this the circles of radiation can be determined, the exposure and concentration figures and the dosage. In effect, a chart something like a contour map has to be constructed before the dosage and the duration of operation can be accurately compiled.

Herein lies the advantage of the DSR calculator. The variables of shape, ray incidence (up to 36 beams 10 degrees apart), concentration, etc, can be symbolised thus:

$$(a \times b \times c) + (d \times e \times f) + (X \times Y \times Z)$$

Thus it will be seen that no less than nine variables must be handled at a given time, and this is a fairly frequent calculation. The DSR calculator facilitates this work by means of the automatic selection of the decimal points and by the inherent transfer feature of the machine.

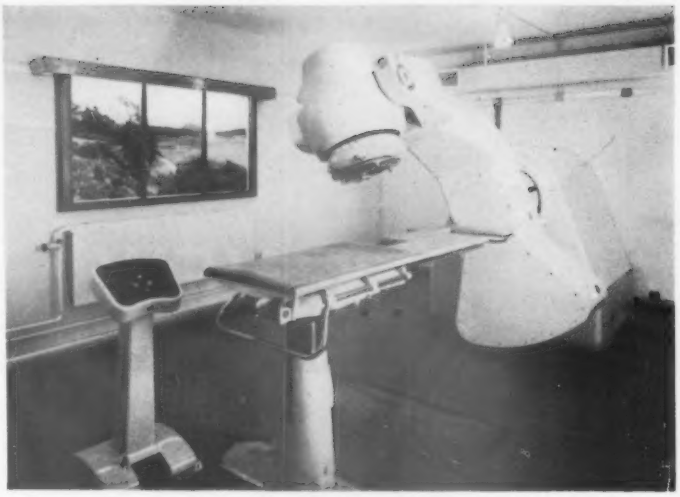
The transfer facility becomes more important as the calculations become more complex. Taking a typical example with one major variable (signified as 'a') the problem would be posed as follows: —

$$\left(\frac{1}{1+2a}\right)^2 \left(2 + \frac{(2a)^2}{1+2a}\right)$$

The value of 2a is retained throughout the calculation and when the numerator is evaluated it is transferred into the independent memory register of the machine. The DSR's independent storage register processes automatic resetting devices, which enables figures to be switched between registers automatically as required by the calculation. The numerator is thus held in the register while the value of the denominator is computed and reset by the automatic transfer device to the main keyboard. The numerator will then be automatically switched into position for the division sum to be completed. When calculations are complete they are shown on the dials of the machine and at every stage the items of calculation, the numerator, etc, keyed into the appropriate register are shown to check the accuracy of key operation. Corrections can be quickly made, and the whole handling of the DSR has been designed to be as simple and foolproof as possible. When 'a' was a known factor, as for example, ·0294, the calculation could be solved in the following way: —

$$\frac{2 + [2 \times \cdot 0294\ (2 \times \cdot 0294 + 2)]}{(1 + 2 \times \cdot 0294)^3}$$

The various calculations relating to the treatment plan may take up to a day to determine, but finally the contour maps with associated instructions would be complete, and the patient be wheeled into the treatment room and placed on a mobile couch below the radiation equipment, precisely in a pre-determined position. The apparatus for beaming the rays is housed in a pear-shaped head of lead construction costing up to £35,000. The core of this equipment is the isotope housed in a lead casing like a giant cotton reel with the beam hole in one side, blocked by a lead shutter. From the core an elaborate optical system projects the beam on to the affected part. The operator, mastering the controls behind a lead glass window, uses a guide light to ensure the direction of the beam is precisely right, and the correct distance and intensity achieved, according to the contour chart. The operator switches on and the shutter is withdrawn from the beam's path; the whole head of the apparatus begins to revolve on its pre-determined path. The work of healing is begun.



Treatment in this room depends on prior calculations

Once the treatment is complete the charts and accompanying details are not wasted. They are passed to the library and used to build up a case-history section. In this way it is hoped to make a comprehensive list of all the most common tumours with their methods of treatment and radiation dosage calculations. About 30 people are treated daily by the cobalt therapy method so that new data for comparison and correlation are constantly coming in. The unit hopes to have the list completed within six months. In this way preliminary work for future treatment can be simplified.

The final verdict on the DSR was passed by a physicist who was one of the research workers in the Cobalt Therapy Installation. 'We are most satisfied with the machine,' he said. 'In fact, I would go so far as to say that without the calculator we could not even have started on the work.'

Photo : the National 390

A Ledger Card Computer

FOR some time now the showrooms of National Cash's headquarters in Marylebone Road, London, have been undergoing a face-lift and with the alterations all but complete, most of the machines in National Cash's present range—from cash registers to computers—were wheeled out over the carpets and demonstrated to a group of bankers recently.

Flown in specially for this demonstration from the USA (and since flown back, regrettably enough) was a National 390 computing system. In the USA the parent National Cash company claim they have installed a number of these machines at NCR data processing centres and have over 100 now ordered and due to be delivered by July.

The 390 computer is a small transistorised machine which works under a stored program and also under operator control. A basic system comprises a magnetic core store in a small central processor, a control console which is, in fact, a modified Class 31 accounting machine keyboard, paper tape or card readers, a single magnetic tape deck and a card punch. Ledger cards can be placed into the carriage of the console-cum-accounting machine on to which information can be printed, but the ledger cards have an additional purpose for they are backed with magnetised strips on to which information can be recorded—the console-cum-accounting machine having the facility to read those strips (in the same way as with the National Post-Tronic machine). Up to 200 digits of information may be stored on the back of a ledger card. This magnetic ledger card combines the advantages of a record that can be read with that of being a computer input.

The 390 working with its tape store can sort, summarise, update balances, handle exceptions, and, of course, control auxiliary equipment. Its input can be via magnetic tape, ledger cards, punched cards or paper tape, and its output can be recorded on magnetic tape, ledger cards, and punched cards.

Designed primarily for bank accounting, payroll and distribution as well as inventory accounting applications the 390 costs in the USA $78,000. Although the British National Cash company will eventually include this machine in their range, it will be some time before it will be available over here, and details of its exact specifications (number of words in core store, etc) are not immediately available. For further information tick DO1 on the reader enquiry coupon on page 41 or write to:

National Cash Register Co Ltd,
206 Marylebone Road,
London, NW1.

Compact Calculator for Decimal Accounts

A FOUR-IN-ONE electronic typing calculator, that will calculate, type out the results on a hard copy and activate a card punch to type out detail or summary cards, is being marketed by IBM in Europe.

The calculator, the IBM 632, consists of three main items, a 10-key companion keyboard: a modified electrical typewriter with automatic programming facilities to simplify operator decision; and a

Calculator has simultaneous card/copy output

compact desk-housed electronic calculator with a magnetic core memory.

The keyboard feeds information for calculation or storage to the calculator, allowing information to be typed and stored for future use, typed and used for instant calculations, stored and used but not typed. The 10-key keyboard is designed for fast one-handed operation, which reduces errors; errors are corrected and can be made through a re-key button before the start bar is operated.

The typewriter is automatically operated through the program unit at the rear of the machine, to type out figures prior to calculation, or to type out the results automatically.

The program is punched into 18 inch mylar plastic tape, giving 180 columns of program space. The program tape moves in step with the typewriter carriage, and instructs the calculator to add, multiply, subtract, and type out the information. This program tape can be removed and replaced easily, as required.

The calculator is able to store information, and add, multiply or subtract the figures read in through the keyboard, according to the program. Eight storage units can each hold up to 10 digits. The unit is able to multiply up to a 10 digit product twice as fast as a desk calculator; add/subtract two digit figures in less than one-tenth of a second; and to cause the results and totals to be typed out. Subject to the program it is able to carry out several automatic operations, such as carrying several totals; tabulations, carriage return, skipping most significant zeros, etc.

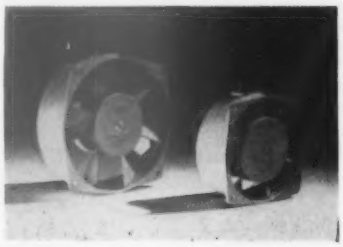
A card punching unit can be connected to the calculator to provide card output automatically as a by-product of the calculation. This operation is carried out simultaneously with the typing output, thereby allowing for a complete written record of the transaction, with a simultaneous card summary.

For further details please tick DO2 on the reader enquiry coupon on this page or write to:
IBM United Kingdom Ltd,
101 *Wigmore Street,*
London, W1.

Hole-and-corner Cooler

A SMALL axial blower, the Plannette, has been developed to provide cooling to computers and other processing and transmission equipments with limited space facilities. The Plannette is only two inches wide, and has a diameter of four and a half or six inches, depending on the model to be used. This means that it can operate in an area too small for the conventional blower.

This could well be an important breakthrough in the vexed question of reducing the over-all size of computers. Transistorised and miniaturised circuits create very much less heat than the older, bigger installations, but nevertheless they do generate heat, and are at the same time more sensitive to heat changes.



Blower breakthrough

Cooling equipment up till now has been out of ratio in size to the need which it has had to fulfil, and contributed disproportionately to the size and weight of the installation. With the Plannette, not only will the user have a small sized cooler, but it may be possible to localise cooling so that transistors giving off more heat than others, *ie*. power transistors, will have more comprehensive cooling. The blower could possibly be built into other mechanised equipments, tape punches, etc, which give off a great deal of heat.

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NEW EQUIPMENT—READER ENQUIRY SERVICE

Use this reply-paid form to obtain more details on any products reviewed in the What's New Columns of this issue.

(Readers outside the United Kingdom will need to add their own postage stamps)

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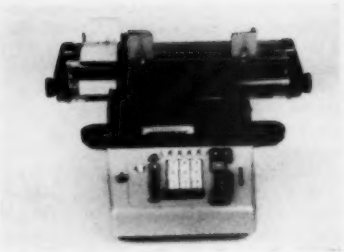
The blower is tropicalised and lubricated for life, and enquiries have been received from a number of equipment firms both at home and overseas. The cost for the 4½ inch model is given as approximately £8 and the 6-inch model just under £9.

For further details please tick DO3 on the reader enquiry coupon on page 41, or write to:
Plannair Ltd,
Windfield House,
Leatherhead,
Surrey.

For the Smaller Business

A NEW add-listing machine with a programmed carriage, the Elettrosumma 22 CR, is designed to give the small business man the opportunity to mechanise all his book-keeping routines. Payroll sales ledger and other 'horizontal' routines can be done on this machine, which can be converted to a vertical add-lister operating with a tally-roll at the turn of a switch.

Tabulators on the machine, carriage advance and reverse, line spacing, non add, etc, are under the control of the program drum, a circular program panel. This drum is replaceable, so that all the standard accounting machines can have their own program. The calculations are carried out through the motor bars, grouped for easy handling, which



Horizontal and vertical accounting.

control addition, subtraction, total and sub-total. The Elettrosumma 22 CR is being marketed for the first time in this country, though a prototype model was shown at the last BEE. It costs £160.

For further information tick DO4 on the reader enquiry coupon on page 41, or write to:
British Olivetti Ltd,
30 *Berkeley Square,*
London, W1.

Noise Excluder for Key-punch

AN acoustical enclosure, a metal noise eliminator which fits over key punches, verifiers, and card-to-tape converters, has been developed by Gates Acoustinet Inc of New York.

The Acoustinet is designed to 'nest' on top of the key-punch without any need for fastening devices. Access to the machine is possible through a tilting glass shield at the front of the cabinet, which also incorporates its own lighting.

The makers say that this enclosure will absorb noise from the punch or other machine before it reaches the office. This may mean not only considerable operator convenience, but will dispense with the need for extensive sound proofing of machine rooms. The enclosure is at the moment sold only in the USA, but several machine manufacturers in this country have expressed interest.

For further details please tick DO5 on the reader enquiry coupon on page 41, or write to:
Gates Acoustinet Inc,
2920 *Sheridan Drive,*
Tonawanda,
New York, USA.

Calculator with Large Storage Capacity

FROM Eastern Germany Broughton & Co of Bristol have imported a new automatic calculator, the Mercedes R 44 SM, shown first at the recent Leipzig Fair. The capacity of the calculator is extremely large; at any given time as many as 20 figures can be accommodated in the store register; 20 figures on the

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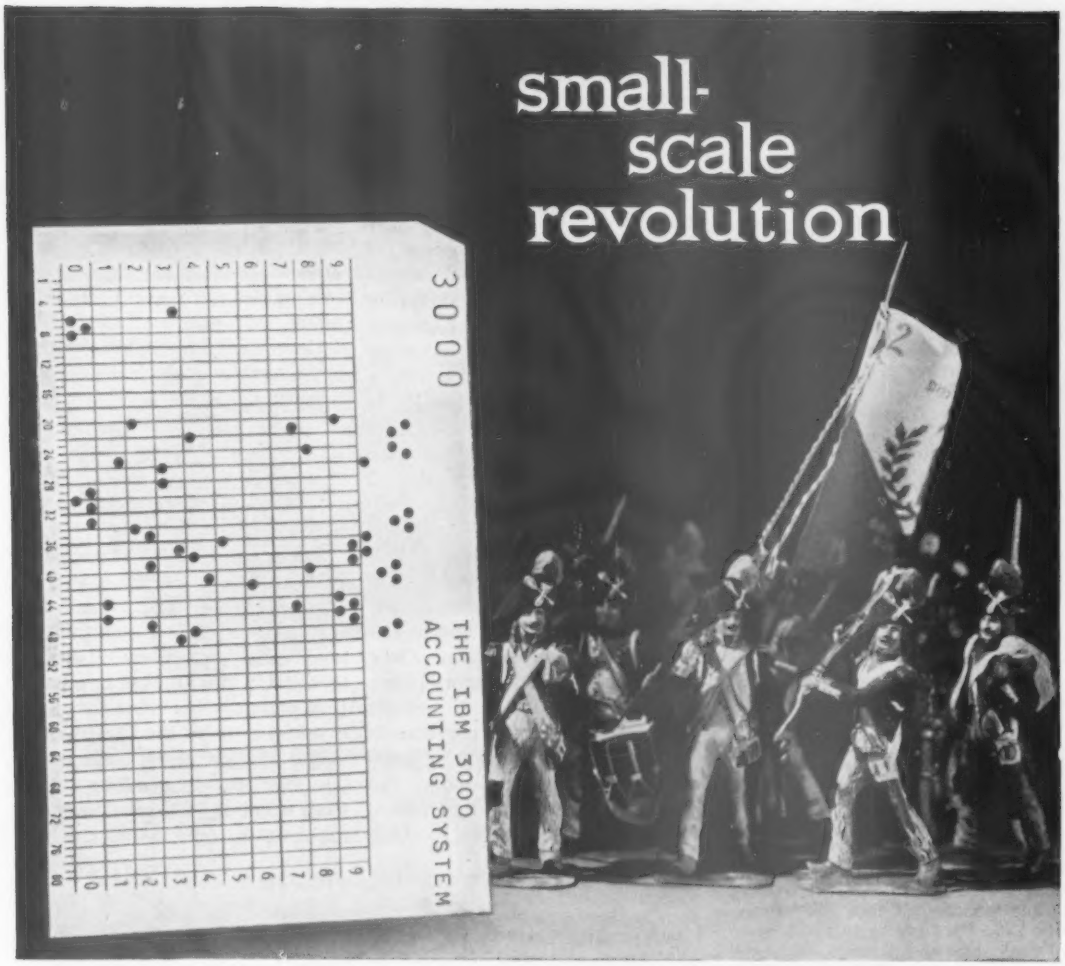


Card shown actual size.

Small, compact, exceptionally low in cost, the IBM 3000 data processing system is a revolution for the smaller business. IBM designed the 3000 system specially for these companies, who can at last have the proved advantages of data processing—accuracy, speed, economy and management control—at a price they can afford.

THE CARD, about as big as a playing card, contains a full 80 columns of information.

THE CARD PUNCH, no bigger than an electric typewriter, is a dual-purpose machine used for card punching and for verification.

THE SORTER sits snugly on a desk top and sorts 460 cards a minute.

THE ACCOUNTING MACHINE:

* Operates at 90 cards a minute
* Performs the normal accounting machine functions, i.e. add, subtract, store, accumulate, select, print and skip.
* Multiplies, divides, acts as a calculating punch, and performs some collator functions.

THE INTERPRETER prints selected information at the top of the card.

No other accounting system in the world combines all these functions in so compact a form.

The demand for the IBM 3000 system is increasing week by week. Of the many already sold in Britain, the first was ordered by a firm of printers, Unwin Brothers Limited. For further details please get in touch with any IBM branch throughout the country, or with

IBM

IBM UNITED KINGDOM LIMITED,
101 WIGMORE STREET, LONDON,
W.1. WELbeck 6600

CRC 87

product and complement register, 20 figures in the quotient register and 20 columns of figures on the keyboard. In this way multiplication and division factors can be set up simultaneously. The eleventh column of the 20-column keyboard is in red, thereby effectively dividing the keyboard. Two multiplicands can thus be entered and multiplied by a constant multiplier. Repeated multiplying is possible, without the need to reset the calculators after each multiplication. Abbreviated division control set to four, six or 10 figures speeds up operations, and by combining a number of functional keys, the method of calculation can be abbreviated. Positive and negative multiplication is also possible.

The calculator can be used for addition, subtraction, multiplication, division, repeat multiplication, and advance mathematical problem, operating at a speed of 500 r.p.m. The machine measures 14¼ inches by 14¾ inches by 6 inches and costs £450.

For further details tick DO6 on the reader enquiry coupon on page 41, or write to:
Broughton & Co (Bristol) Ltd,
6 Priory Road,
Bristol 8.

New Photo-copier with Larger Capacity

A PHOTO-COPIER that handles documents of up to 15 inches wide (with a real copying area of, on average, 13 inches by 16 inches) is announced by Office Mechanisation Ltd. The copying unit makes use of the ' redi-pak ' cartridge to house the developer fluid, thus giving a self-contained carrier for the fluid, that can be detached and replaced, eliminating all need for the operator to handle the developer fluid.

The copying unit is integrated with a full-sized cabinet, in which production supplies, paper, collator racks and working shelves, are housed. Paper ejectors fit into the top of the cabinet.

The copier, model 15-C, costs £145 and delivery time is given as two to three weeks.

For further details tick DO7 on the reader enquiry coupon on page 4, or write to:
Office Mechanisation Ltd,
Ofrex House,
Stephen Street,
London, W1.

New Service Centre

James Wilkes Ltd, the business form specialists, have taken larger premises in Glasgow. New address: 266 Clyde Street, Glasgow C1.

How they prepare to build a car

continued from page 22

and could, therefore, be eliminated. Other refinements are the production of abbreviated information on the track build programme and of codes only on the Leo tapes.

The track build programme for a car is produced in the control room of a new vehicle assembly hall built at the factory. It is planned to move all assembly tracks to this hall, which is highly mechanised. Bodies are accepted into storage and then moved automatically first to the programme stage (this is when the bodies have been programmed) and then, finally, to the building position. These operations are controlled from an instrument panel in the control room. Over the panel the operators have closed-circuit television screens which show them the movements on the production floor. A Flexowriter operator produces the build programme in this room, doing work equivalent to four girls operating manual machines.

Since the Flexowriters were installed it has been found that 60 percent of the models produced have, in the main, a common specification. Instead of pulling an edge-punched card for each individual item on an order it has been possible to create a basic model specification tape which can be fed into the Flexowriter direct to produce the tallies without the necessity of a specification tape for each vehicle.

At the outset it was estimated that the labour saving of the system would be two male and three female clerks in the schedule, invoicing and punched card departments.

There is also an anticipated saving of over £1,500 a year in airmail costs to the USA. For each shipment vast quantities of invoices have been sent by airmail to the US distributing company. It is planned that when invoicing is taken over by the Flexowriters —and this is the next stage of the development—to produce a tape from which the US subsidiary can make out its own invoices.

Computer survey

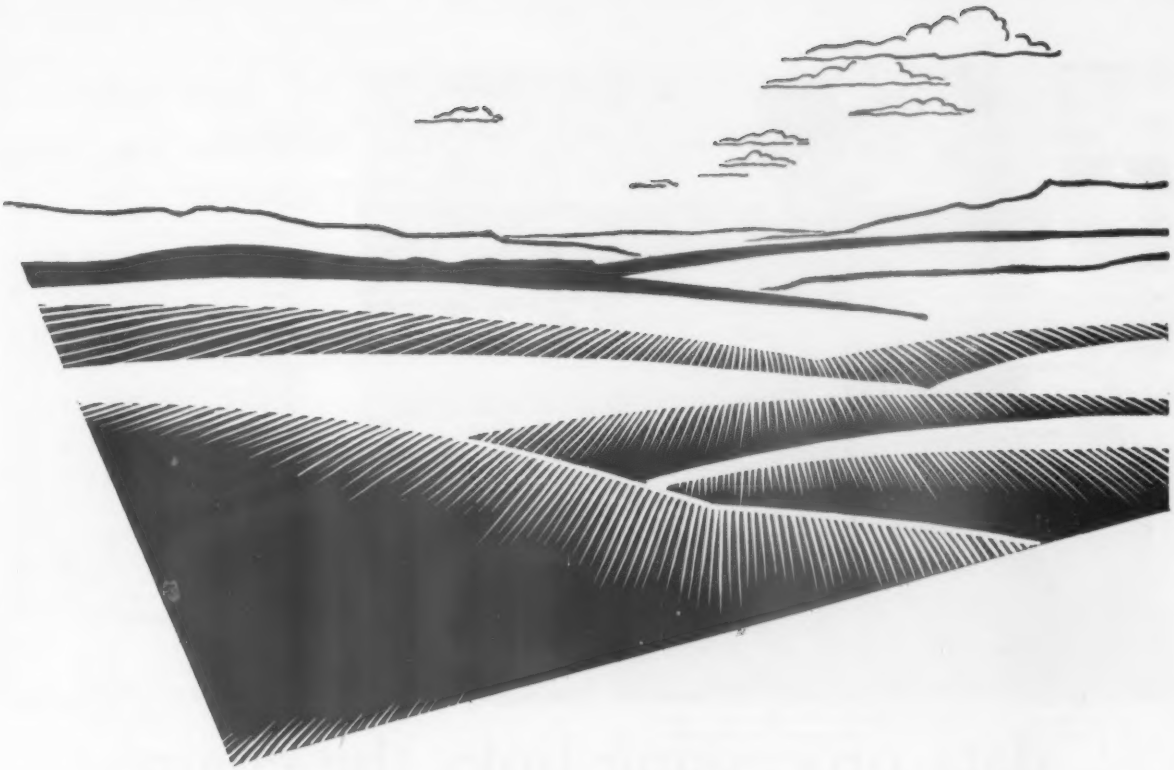
continued from page 37

on the row of five lights that what she has typed corresponds to the copy from which she is typing. If the error is in repunching the cancel key can be applied and the correct combination punched; if in the original the ' reader-code-cut-out button ' is applied, and the correct code is punched. Tape duplicating and editing is also possible.

The Creed high-speed tape comparator

For the comparison of two tapes, the high-speed comparator is utilised. The equipment consists basically of two Model 92 readers, with associated relay comparator unit, power control units, etc, and are able to compare continuously 5-, 6-, 7-, or 8-channel tape. Comparison is carried on at a speed of 26 characters per second, and when disagreement occurs a buzzer sounds and the unit stops automatically. The inching button can be used to detect and mark the error and to continue with the reading. This system is used for tape verifying, and when linked to tape punch and teleprinter, for by-product tape production, and for error detection on communication circuits.

There are two models of tape comparator, the Simple Comparator, and the Perfect Comator, which allows a tape punching teleprinter to be cable connected. The former costs from £301, the latter from £533, to which should be added the cost of the tape punch which is around £400.



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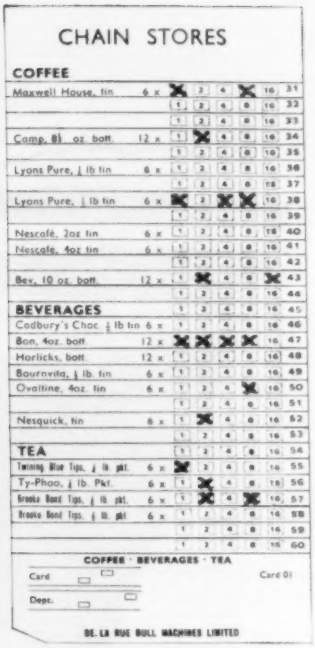
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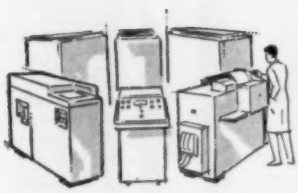

THE GAMMA 3 COMPUTER (*left*)
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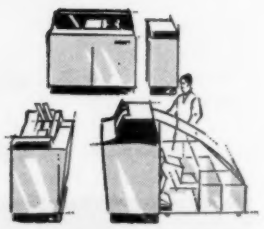

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Applicants should be male and at least 25 years of age, preferably with a pass degree or equivalent qualification. Some experience in computational work would be an advantage. The successful applicant will receive a period of training, and there will be opportunities of promotion.

Initial appointment will be made to the Experimental Officer or Assistant Experimental Officer grade according to age, qualifications and experience.

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Houghton Street, Aldwych, London, W.C.2,

and should be returned to him not later than 1 September

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Computer Systems Analysts/Programmers are required to assist in the investigation, planning and programming of commercial applications to an electronic computer.

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Typists should type

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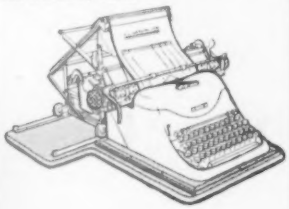
May we send you fuller details of Cat-Quick—or better still, arrange a free demonstration on your own machine and with your own typist. The savings you can effect will then be very quickly indicated.

Cat-Quick is NOT mounted on the typewriter carriage. Running on its own rails, it places no additional burden on the typewriter.

As the form is typed, the frame of the Cat-Quick is pulled forward and with it the carbons attached to the top of the frame by bars.



The spring pulls the frame into the vertical position as the platen is turned back to the top of the completed form. After turning forward the platen the completed set may be torn off with the new set, ready for typing.

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in addition to the well-known

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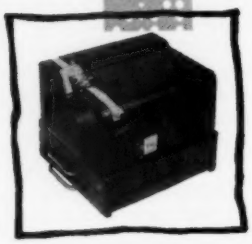

punches tapes, singly or two at a time, in 5-, 6- or 7-track coding, at **25** characters per second.

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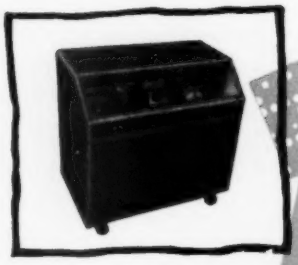

records computer output in 5-, 6-, 7- or 8-track tape at speeds up to **300** characters per second.

they can now supply for medium speed applications the new

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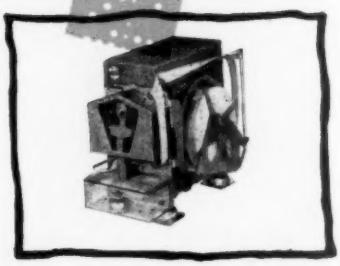

punches 5-, 6-, 7- or 8-track tape at **110** characters per second. A 63.3 characters per second model can also be supplied.

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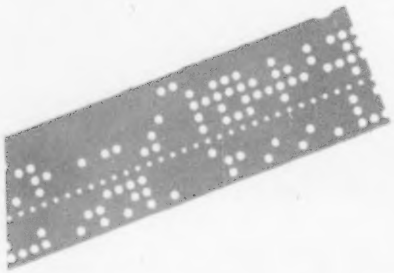

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